SCIENTIFIC AMERICAN

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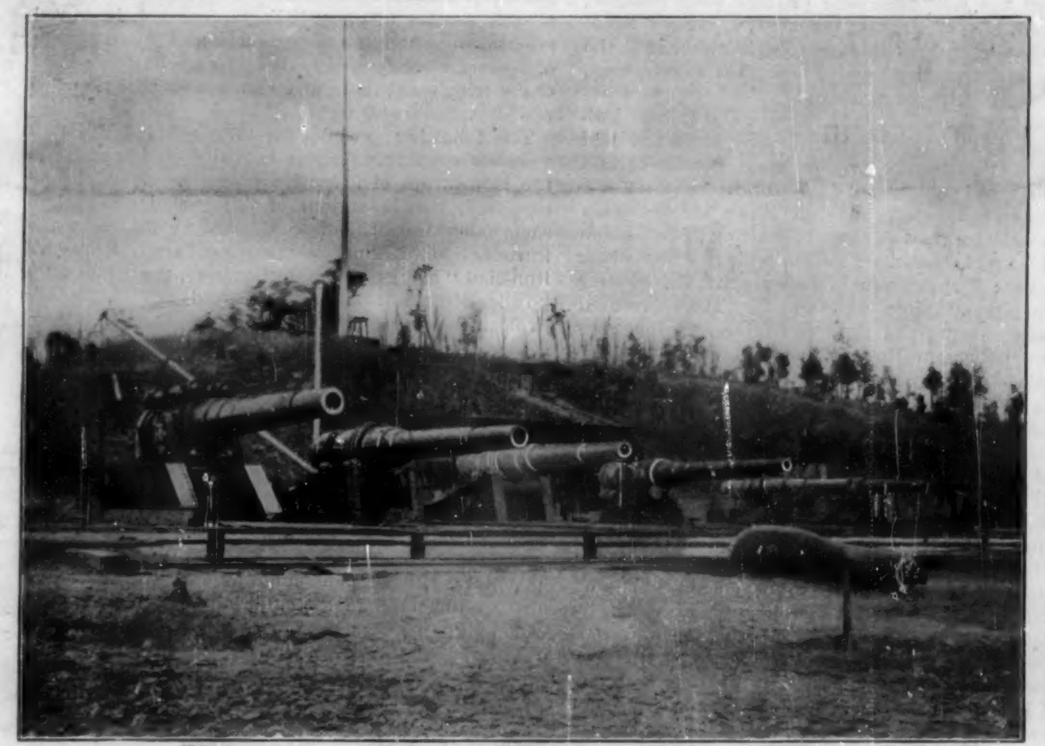
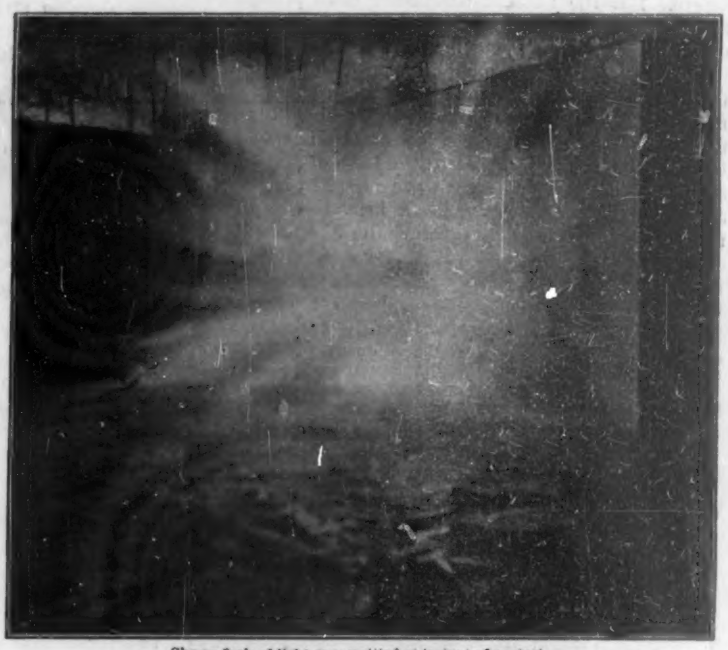


13-inch. 12-inch. 10-inch. 8-inch. 5-inch. 6-inch.

The Proving-Ground Battery.

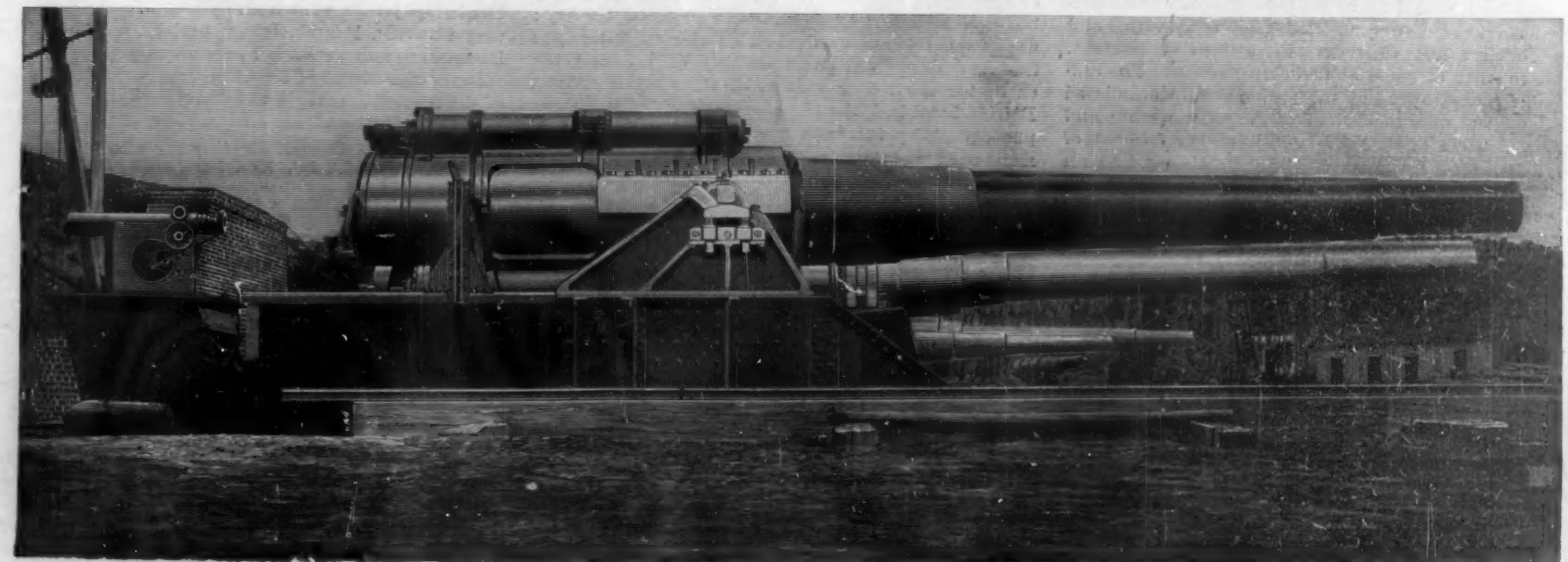
Burning a Doubtful Charge of Smokeless Powder in the Open.

The Discharge of a 10-inch Breech-Loading Rifle.



Shows flash of light-rays emitted at instant of contact.

Photograph of 10-inch Shell Penetrating 12-inch Plate.



13-inch Gun for the "Kentucky," Mounted on Hand-Operated Proving Carriage.

UNITED STATES NAVAL PROVING GROUND, INDIAN HEAD.—[See page 407.]

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NEW YORK, SATURDAY, DECEMBER 29, 1900.

A CENTURY OF PROGRESS IN THE UNITED STATES.

BY EDWARD W. BYRN, A.M., AUTHOR OF "PROGRESS OF INVENTION IN THE NINETEENTH CENTURY."

In no period of human endeavor has the work of man been so built into tangible and enduring things of a useful quality as in the century just about to pass into history. In a few days the calendar of the Christian era will be adjusted to a new figure; the greatest cycle of the world's progress will have completed its round; and the wheel of time will have started on a new revolution. In the evolution of history the thoughtful student is impressed by the great change in methods and subjects wrought by the nineteenth century. Ancient and medieval history dealt with bloody wars, limiting creeds, cunning politics, and the greed of conquest. Modern history must leave these to a subordinate place, and substitute for them, as of greater importance, the genius of invention, the elements and agencies of industrial progress, and the arts of peace; and in so doing it marks the approaching millennium of happiness, good will and material prosperity which men have always longed for. The nineteenth century has given us the first realization of this longing. What is yet to come remains for the future. But the hope of the future must always be founded upon the experiences of the past. What men may do, and what men may dare, are measured largely by past achievements. Progress onward and upward, however, has so monopolized the attention of the nineteenth century man, and has so held his gaze to the front, that he rarely has found time to look back; and yet this retrospect is the faith of the future and the guarantee of further progress. It is timely and helpful, therefore, to make a brief review of the industrial progress of the century, its causes and its effects; for such a review constitutes a sort of stock-taking that discloses to us where we stand, and what we may with reason hope for in future development. So broad is this field, and so diversified its subjects, that space limitations compel its condensation into the briefest expression. Progress along all lines has manifested itself in a remarkable degree, but the great pioneer to it all has been

INVENTION.

In the early days of invention a haphazard and sporadic growth marked the path of the advance; and the brilliant genius of the solitary worker, sometimes a hero, but oftener a martyr, stood out in bold relief amid the apathetic environment of conservatism, and the prejudiced and bigoted atmosphere of superstition. The nineteenth century was to mark in this field a great revolution; speculative philosophy was to be left to the dreamer; and the thought of man assumed a new and more concrete shape. The legitimate claims of matter asserted their equal rights and correlated values with the abstractions of thought, and the era of material prosperity set in. The railroad, the telegraph, and the steam vessel annihilated distance; peoples touched elbows across the seas; and the contagion of thought stimulated the ferment of civilization until the whole world broke out into an epidemic of industrial progress. The germ speedily asserted its living qualities and grew into a new civilization. Invention was its mother, and a free government was its father. To-day a survey of the wonderful industrial progress of this greatest of all countries and greatest of all governments inspires the patriot of the western hemisphere with a justifiable pride, and commands the admiration and respect of the whole world.

When the nineteenth century began, the United States was of limited territory, flanked by England on the north, Spain on the south, and France on the west, a storm-swept coast on the east, and a hostile and ubiquitous host of aborigines in our midst. The necessities of life were still directing the energies of the early settlers almost entirely to agricultural pursuits and to supplying by the quickest methods the immediate wants of food and shelter. It is not surprising then that most of the notable steps of invention at this time should have been taken in foreign lands. As, however, the American people were quick to appreciate and adopt anything of practical value, and as in later years United States patents have been quite generally taken for the most important of these foreign inventions, the latter have become a part of the great working assets of industrial progress in the United States which cannot be ignored in any estimate of the causes of its growth.

In the very beginning of the first decade, Volta, of Italy, had given the world the chemical battery which bears his name; Louis Robert, of France, devised a machine for making continuous webs of paper, which rendered the web perfecting printing press possible; Jacquard, also of France, invented a pattern loom. Somewhat later, Trevithick, an Englishman, built the first steam locomotive; and Winsor, his countryman, organized the first gas company.

In our own land, Col. John Stevens and Robert Fulton successfully established steam navigation and laid the foundation for the present great commerce and splendid naval equipment of the world.

In the second decade (1810–1820) König's rotary steam press marked a great advance in printing; Stephenson built his first locomotive; Fulton built the first steam war vessel; Niepce invented heliography, the pioneer step in photography; Sir Humphrey Davy invented the safety lamp; the English engineer Brunel supplied in civil engineering notable improvements in the methods of driving subterranean and submarine tunnels; electro-magnetism was discovered by Oersted; the American ship "Savannah" utilized steam for the first time for crossing the Atlantic; and Blanchard invented his lathe for turning irregular forms.

In the third decade (1820–1830) Faraday converted the electrical current into mechanical motion, and in experiments in the liquefaction and solidification of gases laid the foundation of the modern absorption ice machines; pins commenced to be cheaply made on Wright's machine; the first public passenger railway was opened in England between Stockton and Darlington; Sturgeon invented the prototype of the electro-magnet; Prof. Henry perfected the same and rendered it effective for all useful purposes in the arts. Barlow's electrical spur wheel, Ohm's law of electrical resistance, Becquerel's double fluid galvanic battery, and Dal Negro's electrically operated pendulum marked other notable steps in the electrical field. Friction matches were introduced by John Walker, Neilson's hot blast for smelting iron was the greatest of the early steps in metallurgy, Stephenson's locomotive, "Rocket," took the prize for speed, the "Stourbridge Lion" was imported and was the first practical locomotive to be put to work in America, Daguerre invented the daguerreotype, and Ericsson supplied the steam fire engine.

In the fourth decade (1830–1840) the United States began to show the fertility and resourcefulness of its inventors to a remarkable degree. Prof. Henry telegraphed signals to a distant point by his electro-magnet and invented his electric motor; McCormick and Hussey invented and put in service their respective reapers; Baldwin built the "Old Ironsides," and from this time on American locomotives began to assert their claims to recognition, until to-day in number and quality they excel all others. Prof. Morse gave the world the telegraph; Colt invented his revolver; Saxton devised magneto-electric machines; the link motion was invented by James; Davenport made his electric motor; Profs. Draper and Morse made the first photographic portraits; and Goodyear discovered the process of vulcanizing rubber. Important steps were also being taken abroad. Faraday discovered magnetic induction, and also established the relation between chemical and electrical force; Pixii constructed magneto-electric machines; Jacobi invented his rotary electric motor and built the first electrically propelled boat; Daniell devised his constant chemical battery; Cooke and Wheatstone devised an electric telegraph; Steinheil discovered the feasibility of utilizing the earth for the return section of the electric circuit; Defries furnished the gas meter; Fox Talbot made photographic prints from negatives; and Prof. Grove made the first incandescent electric lamp.

Ten years more completed the first half of the century, and this decade (1840–1850) brought Sickel's steam cut-off; Triger's pneumatic caissons; Nasmyth's steam hammer; the first telegraphic message from Washington to Baltimore; the introduction of anæsthetics by Dr. Wells and by Dr. Morton; the Hoe type-revolving machine; House's printing telegraph; guncotton and nitroglycerine; Howe's sewing machine; Savage's time lock; Bain's chemical telegraph; Bakewell's facsimile telegraph; Bourdon's pressure gages; Brewster's stereoscope; the Corliss engine; the first submarine cable (Dover to Calais); the collodion process in photography; Sloan's gimlet-pointed screw; and American machine-made watches.

In the next decade (1850–1860) we find Dr. Page's electric locomotive; the Ruhmkorff coil; Helmholtz's ophthalmoscope; Maynard's breech-loading rifle; the Smith & Wesson, the Spencer, and the Henry magazine fire-arms; the Channing & Farmer fire alarm telegraph; Gintl's duplex telegraph; the Watt & Burgess and the Voelter processes for making paper pulp from wood; Wilson's four-motion feed for sewing machines; Bessemer's process of making steel; Hjorth's dynamo-electric machine; Ericsson's hot air engine; Taupenot's dry plate photography; the Michaux bicycle; Hughes' printing telegraph; Woodruff's sleeping car; Perkin's aniline dyes; Siemens' regenerative furnace; iron floor beams in building construction; Phelps' printing telegraph; first Atlantic cable; Giffard steam injector; Gardner's underground cable car system; the discovery of coal oil in the United States; the first use of the electric light in a dwelling, by Farmer; launching of the "Great Eastern;" Osborne's process of photo-lithography; the improved spectroscope, and the Kirchhoff and Bunsen system of spectrum analysis; Planté's storage battery; Reis crude telephone; and Carré's ammonia absorption ice machine.

The following period (1860–1870) included the civil war, but even this terrible calamity could not arrest the momentum of inventive progress. As might be supposed, the inventions of this period reflected to some extent the strife of battle, and we find here the introduction of Timby's revolving turret, Ericsson's iron-clad "Monitor," the Gatling gun, the white gunpowder of Schultz and of Dittmar, dynamite, Nobel's explosive gelatine, the Whitehead torpedo, Moncrieff's disappearing gun carriage, and the rebounding gun lock. The McKay shoe-sewing machine revolutionized the shoe industry. Col. Green invented the drive well. Otis introduced his passenger elevator, the first barbed wire fence appeared, and rubber dental plates were introduced. In this period, also, Louis Pasteur began his great work in bacteriology and established the germ theory of disease. Martin's process of making steel was introduced. Wilde, Siemens and Gramme brought out their several dynamo-electric machines. Burleigh invented his compressed air rock drills, and Tilghman his sulphite process for making wood pulp paper. Oleomargarine was produced, the Suez Canal opened, the Pacific Railway was completed, the first Westinghouse air brakes were devised, the Windhausen refrigerating machines were brought out, and the Mont Cenis tunnel was practically completed.

The next decade (1870–1880) included the periods of the great financial panic in the United States and the critical political strife incident to the contested Presidential election. This retarded to some extent the growth of patents in numbers, but it does not seem to have arrested the thought of the inventor, nor to have affected its quality. The Hoe web perfecting press was developed, and put to work in the office of The New York Tribune. A great array of valuable inventions followed, among which may be mentioned the Locke grain binder; the Ingersoll rock drill; Stearns' duplex telegraph; Westinghouse's improved automatic air-brake; Lyall's positive motion loom; Janney's automatic car coupler; Edison's quadruplex telegraph; Gorham's twine binder for harvesters; Lowe's process of making illuminating gas from water; the roller mill and middlings purifier for making flour; Pictet's ice machine; cash carriers for stores; Prof. Bell's wonderful speaking telephone; cigarette machinery; Edison's electric pen; steam feed for sawmill carriages; Hallidie's cable cars; Edison's phonograph; the Otto gas engine; Jablochkoff's electric candle; Sawyer-Man electric lamp; Berliner's telephone transmitter of variable resistance; Edison's carbon microphone; liquefaction of oxygen, nitrogen, and air by Pictet and Cailletet; the development of the Remington typewriter; Edison's electric lamp with carbon filament; gelatino-bromide emulsions in photography; the Birkenhead and Rabbeth spinning spindles, and the Gessner cloth presses; Siemens also installed the first electrical railway at Berlin; and the Mississippi jetties were built by Capt. Eads. The Lee magazine rifle, Faure's storage battery, and Greener's hammerless gun were other inventions of this period.

In the next decade (1880–1890) the radical inventions of the preceding periods had gotten well into the commercial activities of the national life, and this decade represents the greatest epoch of prosperity the republic has ever enjoyed. It added the following important inventions: Telegraphing by induction, the Blake telephone transmitter, the Reece buttonhole machine, Mergenthaler's linotype machine, Cowles' electrical process of making aluminium, the Welsbach gas burner, the graphophone, electric welding by Elihu Thomson, the McArthur and Forrest cyanide process of obtaining gold, Tesla's system of polyphase currents, Harvey's process of annealing armor plate, De Laval's rotary steam turbine, the Kodak camera, De Chardonnet's process of making artificial silk, nickel steel, Hall's process of making aluminium, the Dudley dynamite gun, photography in colors, and the Krag-Jorgensen magazine rifle. Great advances were also made in explosives and smokeless powders, among which may be named rack-a-rock, bellite, melinite, and cordite. In medicine, antipyrene was brought out, while in bacteriology Koch identified the bacilli of tuberculosis and cholera, Pasteur the bacillus of hydrophobia, Loeffler the bacillus of diphtheria, and Nicolaier the bacillus of

lock-jaw. The first American electric railway was installed between Baltimore and Hampden. "Flood Rock" in New York Harbor was blown up, the Brooklyn bridge was built, the electrocution of criminals ordered in New York, the Lick telescope was erected, and in Europe the St. Gothard tunnel and the great Forth bridge were completed and opened to traffic.

The last decade of the century (1890–1900) is still so near to us, and is so filled with invented agencies of importance, that selection is rendered specially difficult, and only a few of the most important may be named. We find the Parsons rotary steam turbine, which in its applications in marine engines has raised the speed of smaller steam craft to that of an express locomotive; the Northrup loom, which acts almost with the discretion of a thinking mind; the Acheson process of making carborundum, the Yerkes telescope, Edison's kinetoscope, and the allied developments of the phantascope, cinematograph, and biograph, whose moving and apparently living scenes fill the observer with wonder and admiration; the production of calcium carbide by Willson, and the electric furnace for making the same; the discovery and application of the X-rays by Roentgen, the Krupp armor plate, the developments in liquid air and apparatus for producing it by Lindé, Tripler, Dewar, Ostergren, Berger, and others; the mercerizing of cloth under tension to render it silky, the Schlick system of balancing marine engines, the improved disappearing gun, the practical development of the bicycle and automobile, the building and launching of the "Oceanic," the largest steam vessel ever produced; and wireless telegraphy by Marconi.

These represent the most notable agencies which have stimulated the industrial progress of the nineteenth century. Conceived in the progressive thought of mankind, they have been nursed into a healthy and strong existence under the fostering care of the patent systems of the world, and especially by those of our own land. Former ages have furnished many a brilliant genius, but his thought has too often died with him. Will not all agree that it is the patent system which has in the nineteenth century crystallized this thought into enduring records, and in furnishing the stimulus of fair and just reward to the inventor has thus become, more than any other single factor, responsible for the great array of invented agencies and the wonderful industrial growth of the present time?

In this connection it may not be amiss to show what this patent system has produced in the way of original inventions. The growth of patents is graphically illustrated in the accompanying chart, which not only gives the variations in patents in the United States from year to year, but also a comparison of the total number of patents of the principal different countries of the world. It will be seen that up to the end of the year 1900 sixty-five thousand more patents will have been taken out in the United States than in Great Britain and France put together.

On this foundation the modern civilization of the nineteenth century has been built, and from it has rolled the mightiest wave of material prosperity which the world has ever known. Submerged within it and surrounded by it, as we are on every hand, it is difficult indeed to rise to a point of comprehensive vision. Its very magnitude precludes any correct comprehension by the average observer. A mountain cannot be estimated at close range in any proper appreciation of its relative values, and the boundless sea in its vastness furnishes no comparisons; and so in looking at this great tidal wave of industrial growth, we must stand a little apart from it to get any idea of its proportion. Looking down the corridor of time we obtain a better vantage point of view, since this will show us by its shrinking values the juxtaposed relation of the then and the now, as separated by a hundred years.

MANUFACTURES.

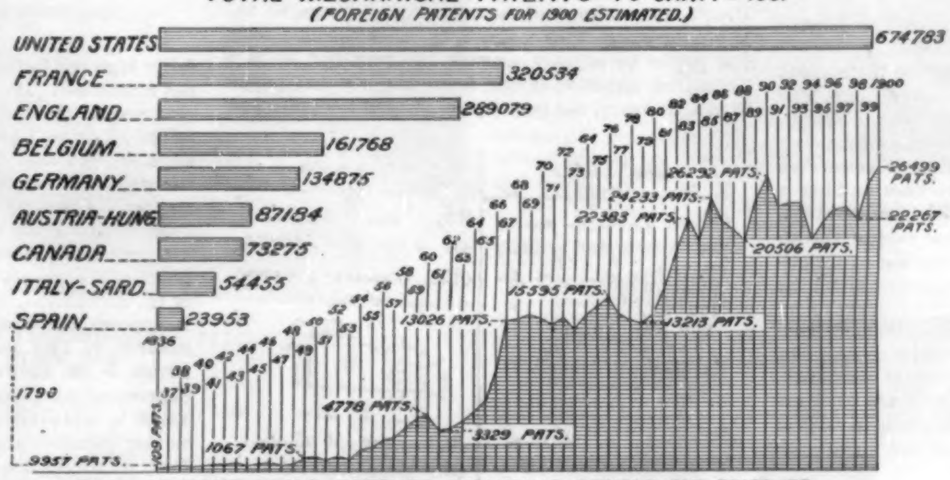
In the year 1800 this branch of the industrial life of the country was of such small extent that scarcely any records of it remain. Some cotton and woolen mills were to be found, but the spinning wheel was still a part of the domestic furniture, more useful than ornamental, the hand loom was the main reliance of the farmer, and home-spun fabric was still in evidence everywhere.

In 1831 the capital invested in cotton manufactures was $40,612,984. In 1890 it was $354,020,843, and the value of the product was $267,981,724. The number of spindles in factories in 1790 was only 70; in 1890, a hundred years later, it was 14,188,103. In 1800 the price of cotton yarns was from $1.03 to $1.36 per pound. In the last decade of the nineteenth century it ranges from 13¼ cents to 18¼ cents, and the price of cloth has diminished in like proportion, while the wages of the cotton mill operatives have more than doubled.

If a man wanted a pair of shoes a hundred years ago, he had his shoemaker to make them, and he had to wait for them until they were finished. The pay of this shoemaker was 73½ cents a day. If he wanted a house, the carpenter with broad-ax laboriously hewed the lumber, and with hammer, saw and hand-plane slowly dressed and put together what is now known as the mill-work, for which he received wages at the rate of something over 70 cents a day. The printer was the skilled mechanic, and at $1 a day he set the type, and worked off on a creaky hand-press the limited edition, whose crude sheets now form valued curios. To-day the shoemaker on the McKay machine makes many hundred pairs of shoes a day, the laborious work of the carpenter is performed almost entirely by the planing, sawing, boring, mortising and turning machines of the great woodworking mills, while the printer, with wages more than trebled and hours of labor reduced, has been elevated to the dignity of an expert manipulator of the linotype machine, performing the work of four or five compositors, or has become the operator of the octuple press, printing papers by steam at the rate of 1,600 a minute, ready pasted, folded and counted for distribution.

In the manufacture of agricultural machines the growth of the reaper has been one of the notable things as bearing on the industrial evolution of the century. This industry began about 1840 with the contemporaneous operation of Hussey and McCormick in this country, and in that year not more than three machines were made. To-day the estimated annual production of the factories in the United States in this class of machines is 180,000 self-binding harvesters, 250,000 mowing machines, 18,000 corn harvesters, and 25,000 reapers; the output of one great factory alone, in the year 1898, being 74,000 self-binding harvesters, 107,000 mowers, 9,000 corn harvesters, and 10,000 reapers. This with 75,000 horse rakes meant for this factory a complete machine for every forty seconds in the year, working ten hours a day. This, however, is only one branch of agricultural machines. There are drills, thrashers, seeders, plows, harrows, and hand implements beyond calculation. In the field of wearing apparel, shoes, clothing, hats, and rubber goods are made in enormous quantities. These with ships, mills for iron and grain, mining machinery, steam engines and locomotives, printing presses, sewing machines, bicycles, electrical apparatus, food stuffs and the thousands of other manufactured products, furnish an object lesson of industrial progress which it is well nigh impossible to adequately estimate and present in intelligible form. The growth of manufactures in the United States, however, is evidenced in late years by the exports of manufactured articles. These for 1900 are $433,851,756, which is 28 per cent above those of 1890 and the largest in the history of the country. Mulhall estimates the total value of manufactures in the United States in 1900 to be $13,326,000,000 and the hands employed 6,710,000.

TOTAL MECHANICAL PATENTS TO JAN. 1ST 1901
(FOREIGN PATENTS FOR 1900 ESTIMATED.)



RATE OF ISSUE OF U.S. PATENTS, INCLUDING DESIGNS AND REISSUES.

RAILROADS AND POSTAL SERVICE.

In 1800 there were no railroads. The rumbling stage coach was the only means of public conveyance. Traveling at the rate of six miles an hour, how long would it take from New York to Washington, and how many relays of horses, and how much delay and discomfort? To-day, a magnificent locomotive and a luxurious palace car whisk us across the country at the rate of nearly a mile a minute. The business man finishes a day's work in New York, and taking a sleeping car eats breakfast in Washington in time to attend an early committee meeting in Congress.

The first public railroad built was the Stockton and Darlington line in England, which was opened for traffic in 1825. In 1829 the "Stourbridge Lion" was imported from England and put to work on the Delaware and Hudson Canal Company's railroad. In 1832, Baldwin built the "Old Ironsides," and from this time on the railroad was an established institution. In the year 1899 the steam railroads of the United States have a total track mileage of 250,362; there are 37,245 locomotives, 26,184 passenger cars, 8,121 baggage and mail cars, and 1,328,084 freight cars. There were 537,977,301 passengers carried, 975,789,941 tons of freight moved, and the total traffic earnings were $1,336,096,379. Mulhall estimates the capital invested in railroads in the United States in 1900 to be $11,380,000,000. To this must be added the enormous growth in street railways with their thousands of cars.

Along with the development of the railroad has come the wonderful extension of the postal service. In 1790 there were in the United States 677 post offices; in 1900 there are 76,688. In 1799 the receipts from postage were $264,846; in 1900 the receipts from postage and money orders are $102,354,579.29. In 1799 the miles of post roads were 16,180; in 1900 they are 500,989. At the beginning of the century postage was paid according to the distance carried, and Postmaster-General Habersham of that period, in one of his reports, recommending a change in the postal rates, remarked that "a postage of 12½ cents or under is so inconsiderable that it is freely paid, but in all cases above that sum it seems something of an object, and it then begins to be called money." To-day two cents carries a letter to Manila, half way round the world. With a special delivery stamp a letter mailed at noon in New York reaches Washington and is delivered to its address by special messenger in the evening of the same day, and the New York daily morning papers are distributed in Washington in time to be read at the breakfast table there on the same day of their issue. For the year ending June 30, 1900, there were 7,129,990,202 pieces of mail matter handled by our post offices. This was about 93 pieces for every man, woman and child of our population, more than half of which were letters and postal cards.

AGRICULTURE AND LIVE STOCK.

The nineteenth century has been remarkable in this field chiefly for the great addition which it has made to our national wealth, the agencies which have contributed to this increase, and the means for economizing the cost of production. At the beginning of the century, a little patch of ground, oftentimes a mere clearing in the forest, and a few domestic animals occupied the attention of the farmer, while the crudest of implements aided him but slightly in his work. At the end of the century 5,500,000 farms are producing annually 2,078,143,933 bushels of corn, 547,303,846 bushels of wheat, 796,177,713 bushels of oats, 228,783,232 bushels of potatoes, 56,655,756 tons of hay, and 10,000,000 bales of cotton. To-day the great Western wheat farms of forty-five to ninety thousand acres and the processions of self-binding reapers in the harvest field stand as correlated factors of growth. More than ten thousand patents for plows, as many for reapers, and a proportionate number of planters, cultivators, thrashers and other implements and tools, indicate the vastness of this field of activity.

Of live stock the United States has, in 1900, 13,537,524 horses, 2,086,027 mules, 16,292,360 milch cows, 27,610,054 other cattle, 41,883,065 sheep, and probably 37,000,000 hogs. The great dairy interest and the enormous meat packing establishments are founded upon these. In the year book of the Agricultural Department the estimated quantity and value of dairy products for 1899 is: Butter, 1,430,000,000 pounds; cheese, 300,000,000 pounds; milk, 2,090,000,000 gallons. This with the skim milk, buttermilk, and whey, and the calves dropped annually, makes the produce of the dairy cows exceed $500,000,000 annually. During the period covered by the five fiscal years 1895 to 1899, the United States exported nearly $3,500,000,000 worth of domestic agricultural produce. The average annual value reached $694,874,000. The agricultural exports for 1900 reached the sum of $835,858,123. What the full production will be in this great field remains for the twelfth census to disclose. Seven hundred clerks in the one division of agriculture alone have been busy for some months tabulating the statistics. This number will soon be raised to one thousand, but not until June, 1902, will the work be complete.

COMMERCE.

A hundred years ago a voyage to the Orient was of only occasional occurrence, and an event of stirring importance to both the commercial world and the family circle. Steam was not yet applied, and the old sailing craft, at the mercy of the seas and adverse winds, might reach her destination and return; but a year's absence was to be expected, and the return was uncer-

(Continued on page 406.)

RITCHIE'S TELAUTOGRAPH.

Compared with the numerous attempts, many of them of exceeding ingenuity, which have been made to construct an instrument capable of reproducing simultaneously a true facsimile of the handwriting of a distant operator, the new form of the telautograph appears to us to constitute an immense step in advance.

The principle is practical, the same as that of Prof. Elisha Gray's original instrument, but the mode of carrying it into effect has been greatly improved. For the facts here given we are indebted to The Electrician and The Electrical Review, of London.

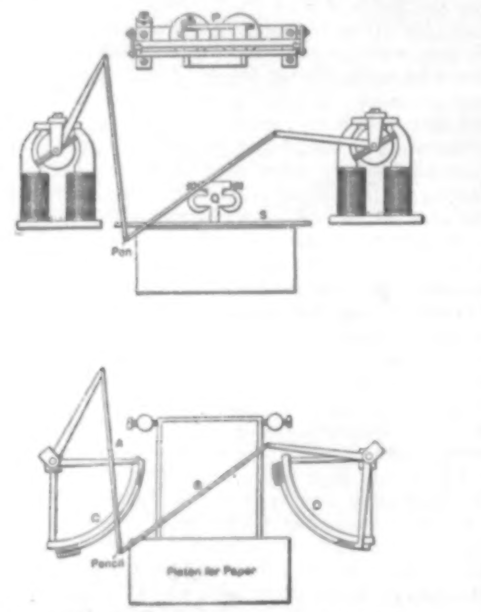


Fig. 1.—PRINCIPLE OF THE TELAUTOGRAPH.

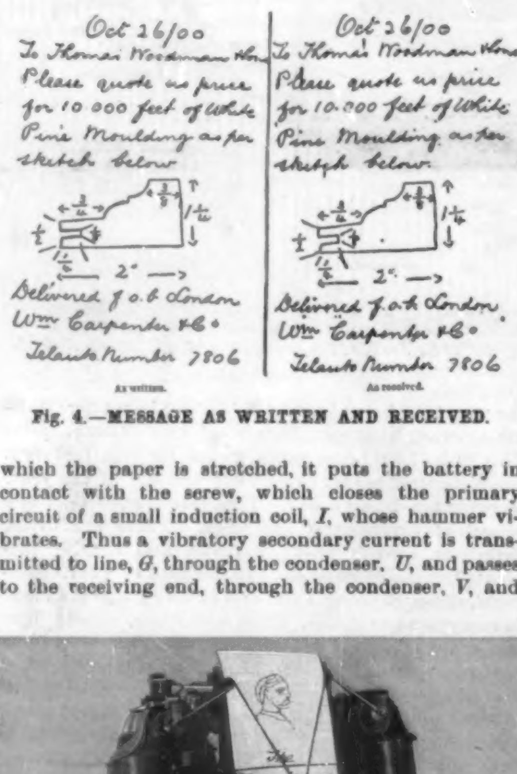
Fig. 1 shows the principle on which the instrument is based and Fig. 2 is a diagram of the connections. The pen is fixed at the extremities of two links, A and B, which are fixed to the arms of two otherwise independent rheostats, C and D. Each of these is connected through the battery to one of the two lines and has a total resistance of 7,000 ohms, divided into 496 steps. One of these rheostats is shown by the side of the instrument in Fig. 3. Thus currents, varying in magnitude with the position of the pencil, are sent along the two lines which connect the sending and receiving instruments. The receiving part of the instrument consists of two large D'Arsonval galvanometer movements, with strong controlling springs to insure constancy. The spindles on which the moving coils are fixed are connected to a link motion corresponding to that of the transmitter part of the instrument, and move a pen along a similar piece of paper.

Having indicated the general principle on which the instrument is based, we now come to its constructive details. As is seen in Fig. 2, a battery is placed at each end of the line, these two batteries being normally in opposition. Before starting to write, the operator takes up the pencil, seen in the general view of the instrument, and, with the point of it, pushes back a lever at the left of the lower or transmitter part. This works a mechanical grip, which clutches the paper and moves it forward about ¾ inch, and at the same time operates a switch reversing the home battery, cuts off the receiving part of the home instrument, and connects up the transmitting portion. A further movement of this lever momentarily opens up the circuit of the home battery, the reason for which will be explained presently. The paper is 5 inches wide, and a length of about 2 inches is exposed at one time. During the motions of the pencil on the paper, currents varying in strength are sent along the lines, F and G, returning in each case by the earth.

The lower part of Fig. 2 represents the transmitting part of the home station, and the upper part the receiving part of the distant station, but the complete instrument in each case is made up of a transmitter and a receiver. H and K are the coils of the D'Arsonval galvanometer movements, these movements being also seen distinctly in Fig. 3. The coils have about 600 turns of silk-covered wire impregnated with shellac varnish, and only the coil revolves, the cylindrical piece of iron at its center being fixed. The magnets are electromagnets excited by the local battery. An interesting feature of the instrument is that, instead of extreme delicacy being attempted in the construction of these movements, the reverse is the case. Twenty-four-volt secondary batteries are employed at each end of the line, and the rheostat naturally forms the greater part of the resistance in the circuit, so that fairly strong currents, telegraphically speaking, flow through the coils. Added to this that the magnets of the D'Arsonval system are highly magnetized, and it is seen that considerable mechanical forces come into play, so that the controlling spring attached to the moving coil is strong, and, as a matter of fact, so strong that the spindle of the moving coil is merely held between centers, jewels being unnecessary. Thus the motion of the coil is decisive and dead-beat, and, moreover, adjustment is easy and the whole mechanism is substantial.

After traversing the moving coil on its way to the distant battery, the current passes on either side through relays, E' and E. These relays are so adjusted that the weakest current (sent when the pencil is at the top left-hand corner of the paper) just suffices to cause their armatures to be attracted. When the current is momentarily interrupted by moving the paper-shifting and starting lever, the relay, E', drops back. This causes the current normally flowing through the paper-shifting magnets, P, to be momentarily interrupted, and the release and re-attraction of the armature of P actuates the grip which moves on the paper. The whole frame rocks backward and forward when the current through the coils is interrupted and re-made. The relay, E, is for the purpose of signaling. A press-key on one side of the transmitter (not shown in the diagram, Fig. 2) on being depressed breaks line, F, and puts line, G, to earth. This causes the relay, E', to release its armature and the relay, E, to make a contact at O, so that the local circuit of the bell, N, is closed and the bell rings. It should be mentioned that to avoid a multiplicity of lines in Fig. 2 all the wires leading to the battery are not shown, but some are broken off and + or − marked against them.

We now come to the ingenious device by means of which no characters are written on the paper at the distant station unless the pencil is actually pressing on the paper at the transmitting end. Motions of the pencil are transmitted to the pen, but the latter does not touch the paper until the pencil does. Normally the "pen-lifting" magnet, Q, is excited by the local circuit, the armature of the relay, R, being against the left-hand stop. This magnet, Q, raises the pen from the paper by slightly moving the cross-bar, S, in a horizontal direction away from the vertical paper. When, however, the pencil presses upon the platen on which the paper is stretched, it puts the battery in contact with the screw, which closes the primary circuit of a small induction coil, I, whose hammer vibrates. Thus a vibratory secondary current is transmitted to line, G, through the condenser, U, and passes to the receiving end, through the condenser, V, and energizes the relay, R. This breaks the local circuit of the magnet, Q, and allows the pen to fall back on the paper. The vibratory current returns by the line, F, and not by earth, so that it does not affect neighboring telephone circuits. The circuit, $KEEH$, has fairly high self-induction, and the relays, E' and E, are not influenced. It is also noticed that the local current reaches Q through the secondary contacts of the relay, E', as well as of the relay, R, so that when the apparatus is not in use and no current is flowing through E, no current is being wasted in the pen-lifting magnet. The same applies to the magnet, P.


Oct 26/00
To Thomas Woodman Hons
Please quote us price for 10 000 feet of White Pine Moulding as per sketch below
$\frac{3}{4}$ $\frac{3}{8}$ $1\frac{1}{4}$ $\frac{1}{2}$ $\frac{1}{4}$ 2"
Delivered f o b London
Wm Carpenter & Co
Telauto Number 7806

As written.

Oct 26/00
To Thomas Woodman Hons
Please quote us price for 10 000 feet of White Pine Moulding as per sketch below.
$\frac{3}{4}$ $\frac{1}{8}$ $1\frac{1}{4}$ $\frac{1}{2}$ $\frac{1}{4}$ 2"
Delivered f o b London.
Wm Carpenter & Co
Telauto Number 7806

As received.

Fig. 4.—MESSAGE AS WRITTEN AND RECEIVED.

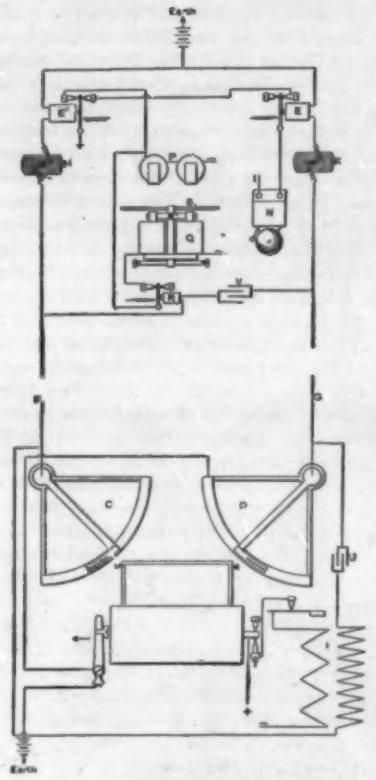


Fig. 2.—DIAGRAM OF CONNECTIONS.

On finishing his message, and before laying down his pencil, the operator must press down, with the point of the pencil, a small plunger key on the left of the instrument, to reverse the home battery so that it opposes the distant one, and to connect up the receiver to line instead of the transmitter. This switch is not shown in the diagram. The action of depressing this plunger also opens a local bell circuit, which is, moreover, opened at another contact so long as the operator's arm is resting on the desk. If, therefore, he retires from the instrument without switching off by depressing the plunger key, the bell circuit is closed, and the bell rings until the omission has been remedied.

A telephone is employed in connection with the instrument. When the telephone is on its hook, the writing telegraph is connected to the lines in the manner already detailed, and on removing the telephone the writing telegraph is disconnected and the ordinary telephone connections substituted. The telephone is seen to the left in Fig. 3.

As already mentioned, a 24-volt secondary battery is employed at each end, and with this the instrument is found to work well on a line up to 300 ohms resistance. The resistance of each of the moving coils is about 185 ohms, and of the relays only about 20 ohms each.

An interesting detail is the pen employed. This resembles a tiny pipe-bowl, from which a thin glass tube conveys the ink to the paper. Each time the paper is moved on by pushing over the paper-shifting lever, and the circuit is thereby broken, the pen returns automatically to the ink-pot on the "isobath" principle. Writing and sketches are reproduced with wonderful distinctness and legibility by the apparatus, as shown in Fig. 4, and, although the hand-writing is somewhat distorted, its character does not disappear.

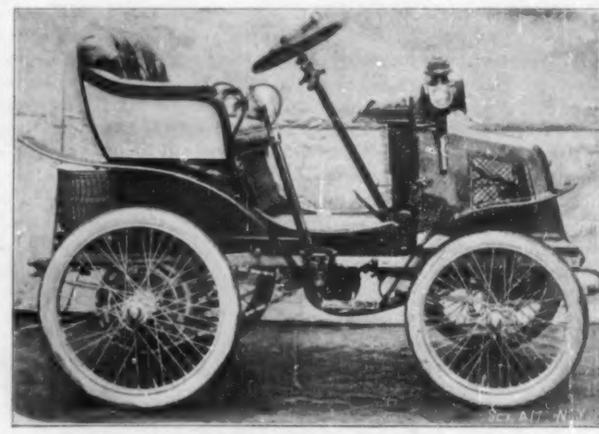
Fig. 3.—GENERAL VIEW OF THE TELAUTOGRAPH (COVER REMOVED).

THE American peanut crop averages about 5,000,000 bushels a year, and 22 pounds of the nuts make a bushel. About $10,000,000 worth of peanuts yearly are consumed, either in their natural form or in candy. The shucks furnish good food for pigs, and the peanut vine forms a first-class fodder for mules. Vast quantities of peanuts are shipped each year to Great Britain and the Continent from both Africa and Asia, where they are converted into "pure Lucca olive oil." A bushel of peanut shells will afford about a gallon of oil, and the meal is used for feeding horses, and is also baked into a variety of bread which has a large sale in Germany and France.

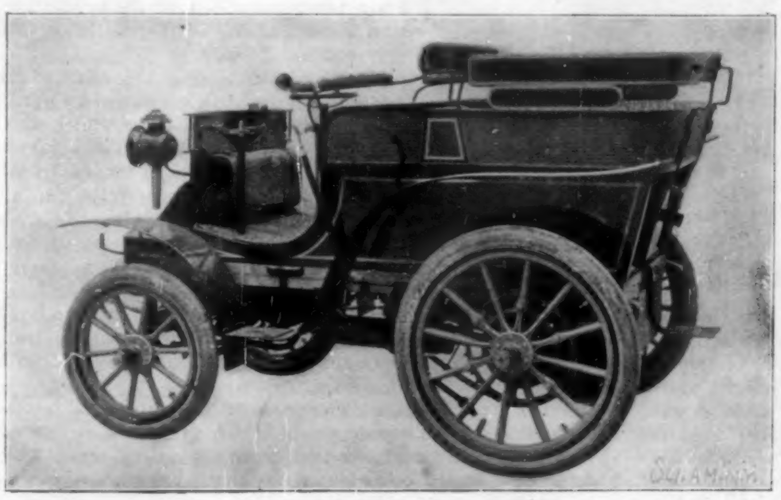
SOME AUTOMOBILES EXHIBITED AT THE PARIS EXPOSITION.

A great number of light vehicles are now being made by the leading firms, to supply the increasing demand for this type of machine; most of these use petroleum motors. The illustration shows a typical machine of this kind for two places, built by the Créanche Company. The same machine may be adapted for three places by adding a light seat in the rear supported upon brackets. The motor is of the De Dion type, of three horse power, with water refrigeration; it is increased to four horse power for the three-seated machine. The motor is mounted in front upon a movable plate, which slides upon the truck. The plate carries not only the motor, but most of the apparatus, the carbureter, water and gasoline reservoirs, etc. It is worked by a lever, which displaces it so as to stretch a belt which passes over a wide pulley which has three times the width of the belt, and allowing the latter to be shifted upon a set of three pulleys placed upon the shaft of the differential. From this shaft a chain passes to the rear wheels. This arrangement gives three speeds, 5, 10 and 20 miles an hour, besides the back movement. The motor is

AUTOMOBILE SECTION IN THE TRANSPORTATION PALACE AT THE PARIS EXPOSITION.



CRÉANCHE MOTOR CARRIAGE FOR TWO PERSONS.



RICHARD MOTOR CARRIAGE.

RICHARD DOUBLE PHAETON.

controlled by a small lever in front, while the large hand-lever seen at the side controls the starting of the machine, stopping, and the different movements without stopping the motor.

Another type of electric vehicle is built by the same firm. It has two places. The motor, of the B. G. S. type, is of four horse power, and operates directly the differential carrying the chain pulleys which drive the rear wheels. The speed-changing, forward and back movement, and electric braking are all controlled by a small handle placed to the right of the conductor, which works the controller cylinder. The batteries are contained in seven rectangular boxes placed three in front and four in rear of the vehicle, and may be easily taken out by doors which let down in front and rear. The accumulators have a duration of over five hours upon a 15 ampere discharge. The motor takes in normal running about 10 amperes at 90 volts. The batteries are arranged so as to be charged without taking them out of the vehicle.

The George Richard Company showed a number of machines, two of which will be seen in the illustrations. Types similar to these were used in the recent army maneuvers. The motors used are 7 and 10 horse power, these differing only in the diameter of the cylinders and the piston stroke; they have twin cylinders whose cranks are 180 degrees apart. The motors have several improvements; the admission of gas from the carbureter is by vertical valves and the exhaust by horizontal valves, operated by cams placed on the shaft which carries the governor. The latter has two masses whose displacement by centrifugal force acts upon the cams and changes their position with relation to the valves. When the motor is working at full load, the two cylinders make their complete admission and exhaust, but when working at less power, at times of slower speed, the regulator eliminates automatically the first cylinder, then the second in whole or part. This is accomplished by acting upon the exhaust and leaving a certain proportion of burned gas in the cylinders. Thus for the first cylinder the action is such that the cam does not operate the escapement valve, and the whole of the burned gas remains in the cylinder, preventing further admission of fresh gas, and consequently the cylinder is inactive. For the second cylinder the cam is arranged so that by shifting it, one-third or two-thirds of the cylinder may be left full of burned gas, with a consequent slowing down, or when entirely full, the whole motor is stopped.

The speed of the motor may be varied at will by acting upon the regulator by a small lever placed in front of the conductor. The lever acts upon the spring of the governor and varies its movement, and thus speeds from 400 to 1,200 revolutions per minute may be obtained; the normal is from 700 to 800. The transmission is made from the motor to the rear wheels by a belt which passes from the motor pulley and around the pulley of the friction clutch, which has on its shaft a set of movable gears for speed-changing; from here the chains pass to the rear wheels. The movable gears are displaced by a circular lever in front of the conductor, which is mounted upon a dial to indicate the different speeds. The clutch for throwing on and off the motor is operated by a foot-pedal. There are two brakes; one of these acts upon the differential, and is worked by a pedal which disconnects the motor at the clutch at the same time that the brake is applied. The second brake acts upon the rear wheels by a hand lever and also throws off the motor. A strong steel frame is used for these vehicles. One of these frames had a severe test in an accident which happened to M. Richard during the "Tour de France" contest. In trying to avoid a vehicle, the axle caught against a tree, and the machine was thrown into a ditch 20 feet deep at the side of the road. The woodwork was smashed to pieces, but the steel frame was not appreciably bent out of shape.

AN electric railroad between Rome and Naples is proposed, the line being 133 miles long. The idea is to furnish fast trains, with frequent service.

Economical Production of Water-Gas.

A new process for the production of water-gas is that known as the Dellwick-Fleischer system, which is now being used with some success in different places in Europe. In this process the production of gas is divided into two periods; in the first, hot air is forced into the grate for about ten minutes, so as to bring the coke to the highest possible temperature; in the second part, steam is sent into the generator, while the temperature is high enough to obtain the decomposition of water, that is to say, from four to five minutes. During the first period the apparatus works like a Siemens generator and permits the dissociation of carbonic acid and nitrogen compounds. The first series of experiments were made at Warstein, in Westphalia, with Essen gas coke containing 87·6 per cent of carbon; 95 cubic feet of gas per pound of coke were thus obtained, but this figure should be reduced to 80, taking into account the coke necessary for the heating of the air and the production of steam. In this way the quantity of gas is doubled. The gas has a density of 0·536 and a calorific power of about 2,000 per pound. It contains 0·75 of hydrogen, 0·20 of carbon monoxide, 3·93 of nitrogen, and 0·88 per cent of other gases. Although the Dellwick-Fleischer process has existed for only two years, it is already considerably used on the Continent, and there are no less than thirty generators in operation which furnish gas for various uses. It is employed specially for tube-welding, in boiler furnaces, etc.

To Our Subscribers.

With the present issue, which will be the last in the century, the SCIENTIFIC AMERICAN closes the fifty-fifth year of its existence. In this long period of time it has chronicled the scientific progress of the times and the important discoveries and inventions, and the history of the latter half of the nineteenth century can be better written from its pages than from any other source. Many subscriptions expire with the present issue, and our subscribers are urged, therefore, to renew their subscriptions promptly, in order that the paper may be received without interruption, as an expired subscription will not be continued after this issue. Those who are not subscribers to the SUPPLEMENT would do well to include this issue in their new subscription, and thus derive the benefit of the reduced combined rates. The progress in the twentieth century bids fair to eclipse even that made in the nineteenth, and all those who desire to keep abreast of the times should subscribe to the SCIENTIFIC AMERICAN.

A CENTURY OF PROGRESS IN THE UNITED STATES.

(Continued from page 403.)

tain. To-day steam has almost entirely superseded sails, and in our magnificent modern ocean liner a trip of five days and as many hours takes us across the Atlantic; then flitting along the coast, up the Mediterranean Sea, and thence through the Suez Canal, we come in contact with all the peoples of the world in less than a month. Steam navigation, first established in 1807 by Fulton, was the great agency of commercial growth. The ratio of steam to sails for the world has increased from 30 per cent steam in 1860 to 80 per cent in 1894. This enormous field of industry cannot be treated except superficially, and we must let the figures tell their own story.

In 1800 the exports of the United States were $70,971,780, and the imports were $91,252,768, or more than $20,000,000 in excess of the exports. Up to 1876 the imports, as a rule, preponderated over the exports. For the last quarter of a century, however, our exports have (with the exception of the years 1888, 1889, and 1893) largely exceeded the imports. In the year 1900 our exports were $1,394,186,371, which is the highest point ever attained. The imports for that year were $849,714,670, which gave us a credit in the balance of trade amounting to over $544,000,000, as compared with a debit of $20,000,000 in 1880. The total of exports and imports for the year 1800 represented an aggregate for our foreign commerce at the beginning of the century of $162,224,548, while that for 1900 is more than $2,000,000,000, which is the largest in the history of the country. Add to this the inland commerce of our great navigable rivers and on the vast areas of the Great Lakes, and the total reaches incomprehensible figures. It is said that over 10,000 vessels are employed in this inland commerce. According to the report of chief of engineers for 1900, the total Lake Superior traffic through the American and Canadian canals for the eight months of navigation ending April 19, 1900, was 21,078 vessels carrying 27,520,205 tons of freight and 51,050 passengers. The traffic through the Detroit River between Lake Huron and Lake Erie is, however, even greater. The freight alone is estimated at 40,000,000 tons, and it is said that the number of passages of vessels through is fifteen times as many as those through the Suez Canal.

Notwithstanding these amazing figures the commerce of the United States is still in its infancy. With the recent acquisition of the Hawaiian Islands, Porto Rico and the Philippines, the development of Alaska, the increasing demand of the world for our products, the building of the Isthmian Canal, and the encouragement to American shipbuilding, the most rational prophecy must seem to many an enthusiastic dream too wild for realization. But the American people are not dreamers.

MINERAL RESOURCES.

In 1800 there had been practically no development of the mineral resources of the country. The abundant forests supplied the necessary fuel, and for most of the people, took the place of coal. There were no railroads, battleships, nor sky-scraper buildings with their enormous demands for iron and steel; coal oil and natural gas were undiscovered assets, and the great electrical art with its demand for copper was not yet born. To-day the annual output of the United States for its principal mineral products is, as given by the Geological Survey for the year 1899, 13,620,703 long tons of pig iron valued at $245,172,654; 585,342,124 pounds of copper valued at $104,190,898; 54,764,500 ounces of silver valued at $70,806,626; 3,437,210 ounces of gold valued at $71,053,400; 193,321,987 short tons of bituminous coal valued at $167,935,304; 53,944,647 long tons of anthracite coal valued at $88,142,130; $20,024,873 worth of natural gas; and 57,070,850 barrels of petroleum valued at $64,603,904. The total production of petroleum in the United States during the past forty years, from 1859, when it was discovered, to the end of 1899, is 943,513,609 barrels. This amount of oil would fill a tank having a base of one square mile to a height of 189 feet, or it would form a river 15 miles long, a quarter of a mile wide, and 50 feet deep. Let the mind try for a moment to estimate the number of lamps which have been filled, trimmed, and kept burning from this supply. The total value of the mineral products of the United States, as estimated by the Geological Survey for the year 1899, is $976,008,946.

FISH AND FISHERIES.

The fisheries of the United States have always been valuable, but in the early part of the century they were superintended only by a kind Providence. Fortunately, the bountiful supply exceeded the demand. In the year 1880 they had attained a commercial value of $13,768,198. In 1871 the Fish Commission of the United States was established, whose principal work was the propagation of useful food fishes, including lobsters, oysters and other shell fish, and their distribution to suitable waters. In the prosecution of its work the Commission has 34 stations situated in different parts of the country, 5 fish-distributing cars, 2 steam vessels and 1 sailing vessel. This institution is now planting in American waters desirable food fishes at the rate of 9,000,000 annually, and they include shad on the Atlantic coast, white fish on the Great Lakes, salmon on the Pacific coast and cod on the New England coast. The value of this national enterprise has long since established itself, and the fishing industry to-day is an important and growing branch of our national resources. According to the Statesman's Year Book for 1900, the fisheries of the United States employ 6,529 vessels and 202,129 persons. The capital invested is $61,868,616, and the annual value of the product is $47,826,328. Oysters constitute about a third of the product.

TELEGRAPH AND TELEPHONE.

In 1800 communication between remote points was only by mail, and the mail was slowly carried by post horses and sailing vessels. To hear from friends in Europe required many months of delay. To-day we communicate with Europe by cable in a fraction of a minute and talk over the telephone with friends a thousand miles away. In 1844 the first line of telegraph was built, under the direction of Prof. Morse, between Baltimore and Washington, by special appropriation of Congress, and the first message over it—"What hath God wrought"—was prophetic of a mighty revolution in the world's life. To-day one great company—the Western Union—has 933,153 miles of wire, 22,900 offices, and in the current year sent 63,167,783 messages. Add to this the equipment and business of the Postal Telegraph Company, and the total would be 1,108,153 miles of wire, 25,900 offices and 80,667,783 messages. Even these figures must be increased somewhat by small companies, the fire alarm and the district messenger service, while submarine cables to the number of 1,500 add 170,000 miles of line and 6,000,000 messages annually in extension of the business of the United States. It is appalling to think how helpless we would have been in our campaigns in the East, and how little hope there would have been for the lives of our compatriots in Pekin, had there been no cable. The telephone, invented by Prof. Bell in 1876 and immediately introduced, utilized in 1899 in the hands of the one parent company a million and a half instruments and over a million miles of wire, and in that year more than five million connections were made daily. The telegraph and telephone are the great distance annihilators and time savers of the nineteenth century, and enter into the life of almost every other industry. They are both American inventions.

THE BALANCE SHEET.

In closing this review no more significant object lesson can be presented than the nation's balance sheet, which for the year ending June 30, 1900, was:

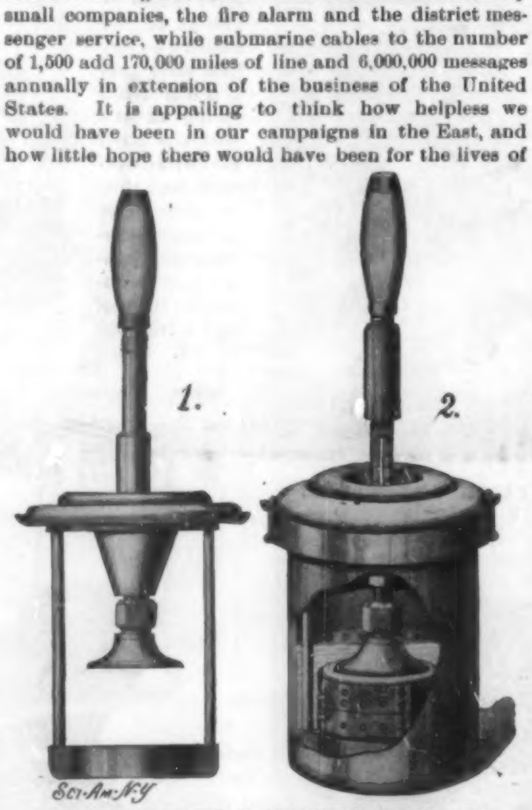
RECEIPTS.	
From internal revenue	$295,327,926.76
From customs	233,164,871.16
From postal service	102,354,579.29
From miscellaneous	38,748,053.97
Total receipts	$669,595,431.18
EXPENDITURES.	
Civil and miscellaneous	$98,542,411.37
Military establishment	134,774,767.78
Naval establishment	55,953,077.72
Indians	10,175,106.76
Pensions	140,877,316.02
Interest on public debt	40,160,333.27
Deficiency in postal revenues	7,230,778.79
Postal service	102,354,579.29
Total expenditures	$590,068,371.00
Surplus	79,527,060.18

This surplus of a single year is more than seven times as much as the entire receipts of the government in 1800, and ten times as much as its entire expenses in that year. To-day the United States is by far the richest country in the world. Its wealth exceeds that of the United Kingdom, which is the next in rank, by about $22,000,000,000. In 1800 our population was 5,308,483; now it is 76,304,799. The sixteen States have grown to forty-five, and our territory expanded from 909,050 square miles to 3,846,595 square miles. At the opening of the revolutionary war there were but 40 newspapers. In 1850 these had grown to 2,526, and to-day we have 20,806. Note also the following growth in national wealth. According to the eighth census, that wealth was in 1789, $619,977,247; in 1850, $7,135,780,228; and in 1860, the highest estimate, by individual returns, made it $19,098,156,289. According to Mr. Mulhall the wealth of the United States in 1890 reached $64,876,000,000 and in 1900 will be $91,040,000,000. This makes in 1900 the sum of $1,195 for each inhabitant. The addition which the last ten years has made to the national wealth is $25,000,000,000. This result in the accretion of national resources is commented on by Mr. Mulhall himself as "really stupendous." Expressing the growth of this period in more comprehensible terms, he says it means that for every day in every year of the past decade the United States has grown (daily) at the rate of 4,000 in population, 800 in school children, 29,000 in acres of farms, $7,500,000 in wealth, and $1,100,000 in manufactures. According to Statistician Powers of the twelfth census, this saving of $25,000,000,000 in ten years is a greater saving than all the people of the Western continent were able to make from the discovery by Columbus to the breaking out of the civil war, which statement seems justified by the figures already given from the eighth census. He also says that the savings of these ten years represent more houses, buildings, machinery, tools, implements, clothes and means of transportation than the race was able to add by its savings from Adam to the Declaration of American Independence.

The infinitude of factors in this epoch of progress is too great for comprehension, and embarrasses the mind in any effort to expand to a full appreciation of its details. The United States, however, has not yet attained its majority, and the future has still great things in store for us. Seventeen million children are in our schools and colleges, and these in the next century will take our places as active workers, and with the masterful equipment of education, coupled with the energy of new blood, a reverent respect for religion, patriotism and morality, and a heritage unparalleled, such forces will undoubtedly carry the republic to a greater prosperity and a more exalted destiny.

A RAPID METHOD OF VULCANIZING RUBBER.

A new method of vulcanizing has been patented by Mr. G. H. Tuttle, of Montgomery, Ala., and Mr. G. M. Bowie, of Whitecastle, La., by means of which it is said only one-third the time ordinarily consumed is required. Fig. 1 is an elevation of the press employed, and Fig. 2 is a perspective view of the vulcanizer, together with a box containing the article to be vulcanized.



THE TUTTLE-BOWIE VULCANIZING APPARATUS.

The apparatus as shown in Fig. 1 consists of a bottom and a funnel-shaped top connected by uprights. Into the funnel-shaped top a screw fits, which also engages the socket of a presser-plate. The socket is in the shape of a nut, so that it can be turned by means of a wrench. Into the upper face of the top a rod screws, which carries a thermometer, a handle, and a protecting sleeve, which can be screwed on a thread on the rod or shifted down, as in Fig. 1, to cover the thermometer.

Between the presser-plate and the bottom a box is to be inserted, consisting of a top and a bottom and perforated upper and lower sections, the several parts being fitted together loosely, so that they can be readily taken apart. The press, with the box, is set into a vessel, the upper rim of which engages a corresponding groove in the top of the vulcanizer, the vessel and vulcanizer being locked together by catches or other fastening devices.

The article to be vulcanized is embedded in plaster-of-Paris in the perforated box; and the box is then placed on the bottom of the vulcanizer. Together with the lower portion of the press, the box is immersed in hot water for the purpose of softening the rubber. When the rubber has been softened, the nut socket is turned to apply further pressure for the purpose of expelling the excess of rubber. Then the press with the box is inserted in the vessel, into which enough hot mercury has been poured to cover the box. The vessel is therefore placed upon a stove. The heat of the mercury passing into the box through the perforations causes the rubber to be vulcanized in the well-known manner. To secure this result, a temperature of about 320° F. is maintained in the box for about half a hour. The box with the vulcanized article is then removed from the vessel and the mercury is allowed to cool.

By this improved method the same results are attained as with the ordinary methods, but in about one-third the time. Moreover, the heating medium is always fully under control, and being a metallic liquid cannot explode.

THE American District Telegraph Company is about to adopt the audiphone system in New York city. The ordinary call boxes will not be done away with, but the audiphone will be substituted where desired. A monthly rental will be required for the new system.

UNITED STATES NAVAL PROVING GROUND, INDIAN HEAD.

BY LIEUT. JOS. STRAUSS, U. S. N., INSPECTOR OF ORDNANCE.

The United States Naval Proving Ground was established at Indian Head, Md., in 1891. Previous to that time experiments in ordnance and gunnery had been performed at what was known as the Experimental Battery, situated on the left bank of the Severn, opposite Annapolis. In the early '80's the name was changed to Proving Ground ; and as the proof of high-powered guns began about this time, the necessity for a longer range and better water communication with the gun factory at Washington determined the Navy Department to remove the proving ground to its present location.

A few acres would be sufficient to accommodate the emplacements for the guns and armor butts, together with the necessary dwellings of those occupied in carrying on the work. It is, however, desirable, and indeed necessary, that the country for a considerable radius should be free from persons or property that might be injured by the erratic missiles which so frequently fly off during the shell and armor tests. To this end about nine hundred acres of land were purchased, and the concrete foundations that hold the heavy gun carriages were laid in a narrow valley leading down to the Potomac.

The guns are arranged in two batteries on each side of this valley. The one on the northern side is arranged so that the guns may be pointed down the river, where there is a clear range of about twelve miles. The velocity battery is on the southern side of the valley ; and as the high land that bounds this narrow plain on the north side is quite bluff, its sloping surface formed a ready-made butt, in which the projectiles were safely buried. As time went on, however, the hillside became the depository of a large number of shells ; new shells fired into the earth would frequently strike a glancing blow on one of these bits of metal, and instead of plowing deeply into the clay until they came to rest, would be deflected upward with terrific energy, and go hurtling over the woods for a half mile or more. So long as they fell within the limits of the government reservation there was no great objection ; but ultimately an errant shell would find its way outside the reservation limits, and this necessitated mining the hillside, from time to time, and removing all the buried metal.

It is an almost invariable rule for every man in the vicinity to take shelter in one of the bomb-proofs whenever a gun is fired. There are four of these, two conveniently located near each battery. They are chambers dug out of the hillside, lined and arched with brick, and heavily walled in front. Generally the guns are fired by electricity, and the leading-wire is simply trailed along the ground to the firing-key within the bomb-proof. In case the gun to be tested has no electrical firing attachment, the lock-lanyard is rove through leading-blocks to the same shelter.

The principal work of the Proving Ground consists in proving guns and testing armor, shell, powder, cartridge-cases, fuses and gun-carriages. The proof of guns consists in firing a certain number of charges at pressures varying from the lowest the gun is likely to be subjected to, to those considerably above its working requirements when mounted on board ship. At each fire the velocity is carefully measured by means of three Boulengé chronographs. The use of three chronographs enables the recorder to throw out any widely varying result, or to discard all three in case all three differ to a great extent. The chronograph room is situated several hundred yards up the hill in the rear of the velocity-battery and is sheltered from shock by a protecting knoll. In firing for velocity, the shot breaks two electric circuits by cutting wires arranged on the screens in front of the gun. These screens are about 100 feet apart, and at 3,000 foot-seconds velocity it takes the shell just one-thirtieth of a second to traverse the distance. The measurements recorded by means of this simple and ingenious instrument are probably exact to 0·002 of a second.

The pressure is measured by three crusher-gages. The gage consists of a small cylinder, closed at one end by means of a screw plug, and at the other by a piston, which is pressed against a disk of copper about one-half inch diameter. The shortening of this disk furnishes a measure of the pressure to which it has been subjected during the explosion.

Armor plates for test arrive at the proving ground secured to oak backing in the same way as they are fastened to the ship's side. The backed plate is then secured against four upright oak balks, whose lower ends are well buried in the ground. These are bound together with cross-timbers and the thrust of the whole structure is taken by four diagonal braces, the lower ends of which are driven into the sand butts.

With heavy, strong plates, the injury to the target structure is always slight. When the plate is light and breaks up, the upright timbers are generally splintered into matchwood; the entire beam seems to be disintegrated. The blow dealt is terrific, and if the plate stands up well, a large part of its energy is expended in crushing and heating the projectile; if, on the contrary, the plate is weak, the energy is dissipated in destroying the target.

The striking force of a projectile from one of the "Kearsarge's" heaviest guns is about 45,000 foot-tons with the high velocities now obtained. It requires something besides mere figures to make this intelligible to the human mind. Perhaps the statement that it is equal to the blow delivered by dropping 300 tons from the roadway of the Brooklyn Bridge to the level of the river below would present it in a more graphic way.

The test of the carriage that holds the gun consists in subjecting it to a series of rounds with the gun elevated finally to its maximum, usually about 15°. The recoil is measured each time, and the working parts of the mount are examined for stress.

The stress to which the carriage is subjected during this ordeal is also serious. Taking the "Iowa's" 12-inch mounts as an example, each time the gun is fired a pull of 200 tons is put on the piston-rod that checks the recoil.

The Proving Ground is the crucible in which are assayed all inventions that relate to guns and armor. It has been the policy of the Navy Department to give a fair hearing to all schemes that possessed on their face the slightest merit. Many of those presented are ridiculous, and are at once declined. Some of them hold but slight promise of success ; but even these are permitted to demonstrate their usefulness or the reverse. Those that show evident indications of value are given all possible aid to bring them into use. It is extremely difficult to convince an inventor of the fallacy of his invention. Arguments to this end are usually met by a threat on his part to sell the patent to some European government. If the device is tested at all, the inventor is usually allowed to witness the success or failure of his idea. As a rule, in case of failure, the results must be overwhelmingly against him to convince him of his defeat.

INDIAN HEAD PROVING GROUND—THE BUTTS, SHOWING METHOD OF SUPPORTING PLATE AND BACKING

Unfortunately, the great amount of testing work that has been going on, incident to the building up of our navy, has prevented much purely experimental research being done. There is a wide field for investigation in the new smokeless powder ; in the effect of lengthening or shortening the gun ; in the question of the variation in pressures along the bore, etc. In some of these investigations the Proving Ground staff has received valuable assistance from the electrically-controlled camera.

Many of the questions lie purely within the domain of engineering, such for instance as the effect on the roller-path when a turret weighing 500 tons is struck by an 1,100-pound projectile having a velocity of 2,000 foot-seconds ? This costly but conclusive experiment, which is illustrated in the Special Army and Coast Defence Edition of the SCIENTIFIC AMERICAN, of July 9, 1898, was actually made at the Proving Ground under the direction of Admiral Sampson when he was Chief of the Bureau of Ordnance.

A modern gun, simple as it looks, is a work of engineering more complex than some of the latest triumphs in bridge-building. The modern armor-plate has slowly developed to its present structure through more than twenty years of costly effort. The evolution of the armor-piercing projectile from the "solid shot" of the Civil War has been marked by a similar progress of scientific investigation, of which the work of the Proving Ground staff has formed an indispensable element.

An $800,000 Award for Patent Infringement.

The judgment recently obtained by Messrs. Benner & Benner against the city of New York in the case of Christopher C. Campbell vs. the City of New York marks the last step in a patent infringement suit which has occupied the courts for nearly thirty years.

On May 24, 1864, James Knibbs received letters patent for a device which has since become known as the "Knibbs relief-valve." It was the purpose of Knibbs' invention to enable a fire-engine pump to operate at full speed, regardless of the number of hose-pipes employed to lead off the water, a purpose which had been previously attained either by shutting off some of the hose-pipes or by opening a waste-valve to permit the escape of the surplus water. Knibbs overcame the difficulties presented by the old system simply by connecting the suction and discharge with a short length of pipe in which a throttle-valve was fitted. By means of this short connecting piece, the surplus water was thrown back into the suction-pipe ; and by means of the throttle-valve the pressure in the hose-pipe could be completely controlled. If the valve were entirely closed, all the hose-pipes would discharge water. If a hose were suddenly shut off, the valve was partially opened to permit the passage of the surplus water to the suction-pipe.

The patent which Knibbs obtained covered not merely the use of this "relief-valve," but also the principle of "returning any excessive water in the force part or section of a steam, fire, or other engine pump to the suction part or section thereof." Broad as it is, the claim was sustained by the courts in the suit for infringement. The mechanical features of the patent are fully described in the SCIENTIFIC AMERICAN of June 5, 1897.

Knibbs assigned his right in the invention to Christopher C. Campbell ; and by Campbell the suits against the city were instituted.

The value of the invention was unquestionable. One year after the granting of the patent, the New York Fire Department fitted its engines with the relief-valve. Payment for the privilege of using the valve was exacted by Campbell ; but the city held that the sum demanded was excessive. A suit begun in the State Court was carried to the United States Circuit Court after a few years of litigation ; but it was not until many more years had passed that the validity of the patent and the justice of Campbell's claims were at last recognized.

When the case came up for a final hearing in the Circuit Court, Justice Wheeler was called upon to decide exactly what sum in his opinion the plaintiff was justly entitled to receive. After passing in review various cases in which the competency of witness to pass upon the efficiency of a device and upon the saving in cost and labor resulting from greater efficiency, Judge Wheeler discussed the several exceptions which had been taken to the Master's report. He decided that men who, although not necessarily experts, were nevertheless by long experience thoroughly familiar with the patented device and with the economy which resulted from its use, were fully competent to give evidence which would enable a judge or a jury to decide to what extent the injured person had suffered. The court, accepting the testimony given by such witnesses, found the saving in hose to be $183,394.32 and the saving in men employed to be $606,344. Adding these sums to the $28,336 which the Master reported were profits from savings in making repairs, the court decided that the plaintiff was entitled to receive $818,-074.72.

This is the second important judgment obtained within a short time against the city of New York for infringement of patented fire-engine inventions. For, on May 19, 1899, the special Master, in a suit brought against the city by the heirs of William A. Brickill, decided that damages to the amount of $894,633 should be paid to them. Brickill was the inventor of the feed-water heater used on New York's fire-engines. The legal controversy which the case aroused lasted for twenty-nine years. The Brickill case was described in the SCIENTIFIC AMERICAN for June 10, 1899.

THE HALFORD GRADIENT RAILWAY.

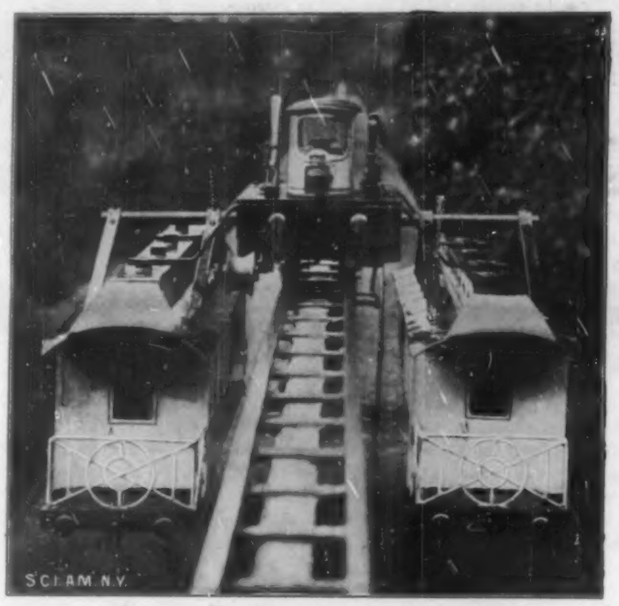
A few months ago, we published in the SCIENTIFIC AMERICAN a detailed description of the Langen Suspension Railway, which is at present nearing completion between Barmen and Elberfeld in the Wupper Valley, Germany. Another principle of the suspension railway has been devised by a Mr. Halford, of London, which is certainly not wanting in the element of novelty. In this system no machinery of any description whatever is applied to the cars. The inventor utilizes the laws of gravity. His permanent way is normally perfectly horizontal; but each of the sections into which it is divided may be inclined at will, so as to produce an inclined plane or gradient. By this means, once the car is started it continues in motion, since the track from one terminus to the other is resolved into one continuous incline. An actual railway has not yet been constructed upon Mr. Halford's idea, but he has erected a small working model, built to scale, of which we present an illustration.

The model is 150 feet in length over all, and is divided into six sections, each measuring 25 feet in length. Each of the sections weighs 100 pounds, and when inclined produces a gradient of 1 in 72. The sections are raised by means of hydraulic rams, which are placed beneath the abutting ends of the sections and at as many intermediate points (in a full-sized track) as may be judged necessary. The sections are joined at the terminals by means of a long pin, which passes through an elongated hole at the end of the girders. An allowance is made at the junctures for the sliding movements of the sections in rising and falling, yet when resting in their normal position the joints are perfectly flush. Fig. 1 shows the general construction of the model. The raising rams are placed at each end, and the column in the center is the supporting ram. The supporting rams can be introduced at frequent intervals, since they simply carry the weight of the girders.

The track consists of a double row of rails, set to a narrow gage, on the upper face of the girders. Upon this track runs a trolley which carries the two passenger cars, one suspended on each side, as shown in our illustration. The center of gravity by this means is placed below the level of the rails, so that comparative safety is assured, notwithstanding the high rate of speed. The trolley itself carries the driver of the train, who occupies a cab in which is placed all the controlling gear of the train.

The raising of the track by the hydraulic rams is automatically accomplished. The accompanying figure represents two sections of the track, A to C. To start the cars at A, the driver, by means of a lever within his cabin, connected with wires controlling the hydraulic rams laid along the track, causes the ram behind him to rise. As the track is resting upon this ram, it is lifted, and a gradient is thus formed from A to the lower terminal of the section at B. By this action the car is placed upon an incline, and as its movements are completely free, it travels to the lower end of the gradient by the mere force of gravity. When within about 5 feet of the hydraulic ram at B, a lever in the driver's cabin automatically depresses a lever, called an actuator, fixed upon the track. The depression of this latter lever opens the valves supplying the hydraulic ram; the water enters the cylinders and gradually forces the piston in an upward direction, lifting the track and trolley, so that now another incline is produced from B to C. The upward movement of the ram is very slow, and the piston does not reach the limit of its stroke until the car has passed the juncture, B. As the cars pass from one section to another, the rams automatically lower themselves, so that the track resumes its former horizontal position. The piston works so smoothly and the track is raised so gradually that the lifting motion is not perceptible. In fact, it appears as if the train were running along a perfectly level track. In the event of the powerful brakes, with which the train is supplied, breaking down or temporarily failing, the driver, by the movement of a lever, can raise the ram in front of him and lower the one behind him, so that the track is converted into an upward incline, which must necessarily retard the progress of the train and eventually bring it to a standstill. By the same means the driver can also regulate his speed. When sufficient momentum has been attained, the driver can decrease the stroke of the ram, thus lessening the steepness of the gradient, or he can throw the hydraulic rams completely out of action, and thus run along a level track. In the model of the railway, the gradient is steeper than it would be upon a practicable railway. Although the model is of interest, the device would be too costly for application to full sized railways because of the enormous expenditure of power involved in raising the deadweight of the track and supporting girders.

Number of Section.	Time Occupied by Cars in Passing.
Starting section	8 seconds.
Second "	6 "
Third "	4½ "
Fourth "	3½ "
Fifth "	2½ "
Sixth "	(barely) 2 "



A GRADIENT RAILWAY—END VIEW OF TROLLEY AND CARRIAGES.

It will be seen from the above that there are possibilities of high speed in this method of locomotion, though it does not possess sufficient advantages to enable it to replace the present system of railroads. The initial outlay for the construction of the track would be great, although at the same time it is true that there are no locomotives to keep in repair, and the wear and tear upon the track would be reduced. Costly machinery would be necessary in the way of central station plants, for the purpose of pumping the water for the hydraulic rams. In a full-sized railway, of course, the weight of the superstructure, which would consist of a series of massive bridge girders, would be enormous, but this should offer no insuperable difficulty in view of the fact that a pressure of 1,000 pounds to the square inch is frequently employed in hydraulics.

There is one great advantage it possesses over the ordinary railway that cannot fail to impress one. On the present railroad systems, when the weight of the train is increased the speed is diminished, but on the Halford Gradient Railway the increment of the load has just the reverse effect, the heavier the load the greater the speed. Recently, by special request, Mr. Halford demonstrated his system to the members of the British Institution, and considerable interest was evinced in the invention by the scientists of that association.

Fig. 1.—SIDE ELEVATION OF SECTION OF RAILWAY.
A A, hydraulic raising rams; *B*, supporting ram.

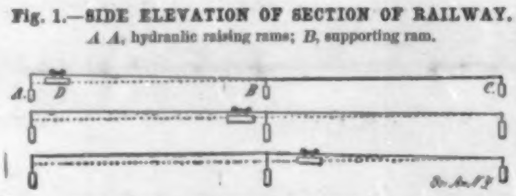


Fig. 2.—DIAGRAM SHOWING RAISING OF TRACK BY HYDRAULIC RAMS DURING PROGRESS OF TRAIN, *D*.

A SECTION OF THE TRACK, SHOWING THE TRACK GIRDERS AND HYDRAULIC LIFTING-JACKS.

Toning of Bromide Prints.

It is often found desirable to change the tone of bromide prints, and a number of processes have been devised for accomplishing this; one of the best of these methods is that which has been recently described by Mr. Ferguson in a communication made to the Royal Photographic Society. Mr. Ferguson has been experimenting in this direction ever since 1895, and has at last perfected a process which is claimed to give fine results with bromide paper or glass transparencies. In this process the toning action is brought about by the use of ferricyanide of copper; this is formed by adding 75 parts by weight of sulphate of copper to 66 parts of ferricyanide of potassium, both having been dissolved separately. On adding the two solutions a greenish-gray precipitate is formed, which, however, is not very stable and is difficult to separate by filtering; it is best separated by decanting the liquid and washing with water. After several changes of water most of the remaining sulphate of potassium solution is removed.

The ferricyanide of copper is now to be dissolved in order to form the toning bath. Mr. Ferguson, after a number of experiments, found that the citrate of potassium was by far the best solvent, although the oxalate may also be used. To make the toning bath, 10 per cent solutions of neutral citrate of potassium, sulphate of copper, and ferricyanide of potassium are made; it is best to use distilled water. The solutions are mixed in the following proportions:

Citrate of potassium, 10 per cent solution	250 parts.
Sulphate of copper, 10 per cent solution	35 "
Ferricyanide of potassium, 10 per cent solution	30 "

Add the sulphate to the citrate, mix, and add the ferricyanide, when the ferricyanide of copper formed remains in solution. The solution may be used in various strengths, but it is preferable to dilute it to one-twentieth. The prints, which have been developed somewhat stronger than usual, are washed carefully after fixing, and placed in the bath, being kept in movement. In a short time a warm black is obtained, which soon passes to brown, then purple, and finally to red tones, with a diminution in intensity of the image. Positives on glass may be also toned by this bath. Mr. Ferguson states that remarkably fine colors are obtained by this toning process, and recommends it to all persons who wish to vary the ordinary tone of bromide prints.

Trans-Siberian Train Lighting.

The trains which are now running over the section of the Trans-Siberian from Moscow to Irkutsk are provided with a complete electric system which serves for the lighting and heating of the cars, as well as for the water and milk heaters in the dining car. In the baggage car has been placed an installation consisting of a boiler, a steam turbine and a dynamo of 5 horse power, which gives the current at a tension of 65 volts; the plant is under the supervision of an engineer appointed for the purpose. Under one of the cars is disposed a battery of accumulators, which assures the lighting for four hours in case an accident should happen to the dynamo plant, and the latter may be stopped during the night when only a few lamps are in use. Electric cigar-lighters are placed in each compartment.

The lighting is carried out by globes placed in the ceiling, by brackets and portable lamps. The globes of the sleeping compartments, corridors, etc., contain two lamps provided with a switch; the others have one lamp. The portable lamps, which are usually suspended from the partitions by brackets, may, if necessary, be placed upon the tables. The lamps are from 5 to 16 candle power, according to their position; the whole number of lamps in a train represents 1,000 candle power. The circuits are so arranged that most of the lamps are turned off after midnight. In the sleeping compartments the lamps which illumine each has an automatic switch by which it is extinguished or turned on as the curtains are drawn or opened.

THE London County Council Fire Brigades Committee are considering the question of motors for fire apparatus.

LOGGING IN THE NORTHWEST.

BY D. A. WILLEY.

As the forests of Oregon and Washington are being more thoroughly explored by lumbermen and prospectors, the size and extent of the tracts of timber are becoming more appreciated. For many years California has enjoyed the principal reputation for being the location of groves of the great redwoods. The species of fir found in the valleys of Oregon and Washington on the western side of the mountains are believed to be the largest of their kind in the world, and really rival the redwoods in girth and height.

Of recent years lumbering has been carried on extensively in the forests referred to, as the size of the timber and the many purposes for which this kind can be used have been strong incentives to the organization of companies and the building of sawmills. As yet, however, the operations of the timbermen have been confined to a comparatively small area, owing partly to the lack of transportation facilities and partly to the difficulty attending the work of getting the logs conveyed to market. The ordinary portable sawmills so commonly used in the Southern States, Maine and Canada are not large enough to utilize in the larger growths of Oregon firs, as they are frequently found of a diameter ranging from 12 to 15 feet near the ground, and with trunks which are available for cutting into logs to an extent of 350 to 375 feet. The measurements taken of some of the largest specimens show that they actually grow to a height of over 400 feet, including the topmost branches. This is over two-thirds of the height of the famous Washington Monument. Like the redwoods, the branches are not reached until one has scaled the trunk to a distance of sometimes 50 and 60 feet above the roots. As to the latter, they necessarily extend into the earth a great distance, and some of the stumps which have been removed have had roots which were 2 feet in diameter, reaching a distance of 40 feet from the tree proper.

LOGGING SCENE IN WASHINGTON.

Lumbering amid these forests differs in many respects from the industry as carried on in other portions of the country. The task of felling a tree of the size mentioned is attended with much difficulty, and great care must be used not only to prevent accidents, but to avoid the splitting or injury of the trunk in other ways. The direction in which it is to be cut down is, of course, first selected, and advantage taken of the character of the surface. If the ground is soft by reason of being marsh land, or is overgrown with saplings or heavy underbrush, this favors the lumberman, who is not obliged to prepare an artificial bed of piles of branches and leaves. In case the tree grows from a slope, it is generally cut with the crown pointing up so as to fall aginst the slope, thus lessening the distance of its descent. The larger ones are sometimes felled in such a direction as to strike against a smaller tree of no value, which will break the force of the fall and allow the trunk to be lowered slowly to the ground. In cutting a tree 300 feet in length, calculations must be made of its great weight and its length. There is little comparison between this work and that of felling a pine 100 feet high and but 3 or 4 feet in diameter at the base.

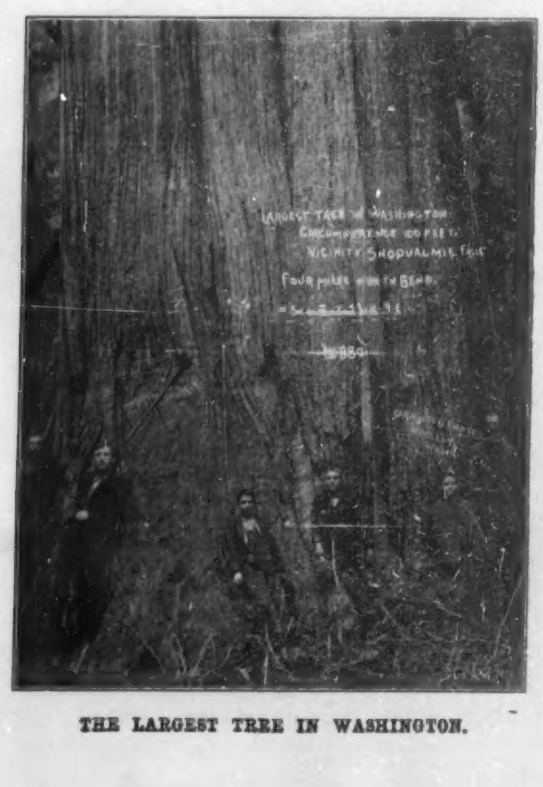
With the bed prepared, the axmen begin work, usually four in number, two on each side. In cutting

FELLING A LARGE FIR TREE.

they follow lines marked on the bark, which indicate the width and depth of the fissure to be made. When a tree is 10 feet in diameter, about 3 feet will be cut away on the side on which it is to fall and 2 feet on the opposite side, leaving the balance for the sawyers. These figures, however, may vary a foot or two according to the size of the tree. The axes used are about the size of the ordinary felling ax common to Southern lumbermen. The metal part weighs from 4 to 6 pounds, and is sharpened on both sides to the finest cutting edge. Experienced axmen will make a cut into the trunk which is almost as clean as if it had been sawed. That part of the work done, a cross-cut saw is inserted in the side on which the tree is to be felled. This is considerably larger than the average used in the pineries. It has the M-shaped tooth and is of cast steel from 5 to 8 inches in breadth, being widest in the middle and tapering toward the end. It ranges from 7 to 10 feet in length, and is sometimes operated by two, but oftener by four men, where the tree is of extra large size. The balance of the cutting is done by the saw, and it is removed when the foreman of the gang deems that it is unsafe to proceed further. Possibly a foot of the solid heart may be left untouched, or in other words the tree is supported by this much. Frequently wedges are driven in each side to furnish an artificial support, which allows the sawyers to cut away more of the timber. Then the saw is withdrawn and the wedges on the side where the tree is to fall are knocked away, the operation being something like the launching of a vessel. Another form of completing the work is to take away the saw while the tree is still firm, and chop away enough from the side on which it is to fall to overcome the equilibrium. Then a crack is heard, and as the lumbermen hasten to a safe place the great mass comes down with a force which presses it sometimes several feet in the soft ground or crushes the piles of branches forming its artificial bed literally into kindling wood. Occasionally steel wedges with sharp points are used to finish the work instead of axes. After the saw is taken out, they are driven in on the proper side until the tree begins to bend. On account of the large number of branches and their length, one of these trees, if isolated any distance from the others, feels the force of the air currents, and sometimes advantage is taken of a strong wind to cut down the tree so it will fall in the direction which the wind is blowing. Judgment must also be exercised in cutting during gales of wind, as serious accidents have happened on account of the force of the air throwing the tree in the wrong direction.

With the tree felled, the next step is to transport it to the mill, either entirely or in sections. As the mill may be 50 or 100 miles distant, streams with a sufficient depth of water are utilized when possible. The tramroad also plays an important part in the operations. In a forest containing a heavy growth of fir, a line is built to the nearest railway or rafting stream. It is equipped with the usual logging locomotives and flat cars, each capable of carrying a 30-foot log. A portable steam engine is then carried to the end of the tramroad and set up. It operates a drum on which is

LOADING FIR LOGS.



THE LARGEST TREE IN WASHINGTON.

wound several thousand feet of wire rope, sometimes hemp rope. It furnishes the power for a cable-way which can be used to great advantage in transferring the trunks or logs to different points within a radius of a half mile or so. The cable is run over a series of pulleys attached to convenient supports; to one end are fastened steel hooks or grips large enough to haul the great bulk. If it is decided to carry the tree from its resting place to a position where it can be cut to better advantage, the cable is secured to one end and a path prepared over which it can be pulled or slid by laying down round pieces of wood and pouring grease or water upon the surface. In this way a trunk 200 feet in length can be pulled a distance of 1,500 or 2,000 feet, if desired, by steam power. The more common way of carrying the larger trees in these forests, however, is to cut them with cross-cut saws into 20, 25 and 30-foot lengths and then pull them to the tramroad. By means of the cable-way they are placed upon the cars in the usual manner. If the tramroad terminates at the water's edge, a raft is made of the logs in the usual manner, although but a few can be placed together, on account of their unwieldy size and the danger of guiding them, especially in streams where the current is very swift. They are then taken to the mill, and stored in the "boom" or reservoir, until ready for the saw table.

Advantage is taken of the winter season in lumbering in these forests, as the snow forms a slippery surface on which to haul or shoot the logs. Consequently, much of the cutting is done in the fall season, and then all hands give up this work and turn their energy to getting the cut trees to the mill. Where steam power is not used, teams of oxen are substituted, as they are found to answer the purpose much better than horses, and have more endurance. A "string" of 25 or 30 oxen will haul a trunk from 150 to 200 feet in length without difficulty, if the grade of the road is not too steep and a pathway has been properly prepared. In winter, as already stated, the snow can be used to great advantage; but at other seasons of the year the road is made through the forest by laying limbs of trees, from which the bark has been peeled, closely together and throwing leaves and dried grass upon these, the plan employed being very similar to that in making a corduroy road. This is made slippery with either grease or water, and the trunk or logs pulled by the oxen to their destination in the usual manner. Some of these roads in Oregon are nearly 50 miles in length, and reach from the cutting district to the mill.

The millwork in connection with the big trees is quite similar to the industry in other parts of the country, except that special saws have to be used. Band saws of extra large size, made of the finest steel, are generally employed for cross and lengthwise cutting. Of course the saw tables must be made purposely to receive these logs, which are so high that a man standing on another's shoulders cannot look over the top of one of them. The mills are operated by water power; where it is available, although most of them have an auxiliary steam plant, ranging from 100 to 200 horse power, yet such is the quality of the equipment that logs 10 and 12 feet in diameter are cut into beams, planking, and boards as quickly as those of ordinary size. The great width of the planks requires much care to prevent them from splitting, and special carriages have been invented to take them from the saw table to the lumber pile when it is desired to utilize them in their original width. The demand for extra wide boards and planks, however, is but small, and the majority of the logs are converted into lumber of an ordinary building size. The lumber companies frequently make a good advertisement of their wares by constructing offices and small cottages of four boards cut from a single tree, one board forming a side or end, with enough cut off from the ends to supply the shingles for the roof. Some of these buildings are 10 feet high, from 12 to 16 feet in length, and 8 to 10 feet wide. The doors are formed by cutting out the required hole in the plank and fitting the piece of wood cut out with hinges, locks, and the necessary latch.

As already intimated, the size of the firs of Oregon and Washington in many cases rivals the dimensions of the famous redwoods. In fact, they are so large that dimensions are given which are scarcely credible. In going through some of the forests the traveler will see at a distance what he thinks to be the side of a cottage without windows. On nearer approach he finds that it is the uprooted stump of a large fir with the sawn side toward him. On the top of some of these stumps, 25 or 30 people could sit without difficulty and have room to move. Occasionally the timbermen find one with a decayed spot in the interior, but the great majority of the large trees are very sound, and for this reason are especially valuable for lumber. They are used for ordinary structural work, also shipbuilding to a certain extent, and for other purposes where wood which is light in weight is desired.

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SKID ROAD AMONG THE WASHINGTON CEDAR AND FIR TIMBERS.

Across Europe in a Balloon.

Count Henry de la Vaulx, a member of the Aero Club of France, who recently ascended in a balloon from Vincennes, France, for the purpose of traversing Europe as far as possible, has recently returned to Paris, a holder of the world's record for long distance ballooning. The feat accomplished by the aeronaut was a trip of 2,000 kilometers from France to Kiew, Russia, 1,300 kilometers (812½ miles) of which was made in exactly 24 hours.

The balloon in which Count Henry covered this remarkable distance in record-breaking time is known as the Centaure. During the Exposition, a wager had been posted by the owner of the Centaure that it could easily outdistance any balloon in the Aero Club. Accordingly, at exactly 20 minutes past 5 on the afternoon of the 9th of October, the Centaure rose gracefully over the roofs of Vincennes, and hung for some time suspended until the gathering twilight blurred and finally blotted out its shape altogether. Fifteen minutes later, however, the moon broke forth, and bathed the Centaure with a sheen of light, showing up the flying villages below quite distinctly to the occupants of the car.

In ascending the Centaure had reached a height of 2,000 meters. This altitude it retained for some time. Among the towns and cities traversed, Rheims was easily recognized by reason of its famous cathedral. The ancient steeple served for some time as an excellent guide. The wind forced the Centaure along toward the east, which is regarded as the most favorable direction for Continental balloon trips, and the pace was rapid and the temperature agreeably mild.

When the sun arose, little difference was noticeable in the altitude of the Centaure. In crossing the kingdom of Bavaria, recognized by its geographical peculiarities, the aeronauts descended several hundred yards in order the better to make observations. Toward 6 o'clock in the morning the balloonists were startled to perceive a second and larger balloon, which they had not before noticed, following at a respectful distance in their wake. It turned out to be another Paris balloon, by name the St. Louis, directed by M. Balzan. For almost five hours the St. Louis remained in sight. A few clouds covered the sky, and caused the Centaure to sink rapidly whenever the balloon fell within their shadow. It rapidly regained its former height, however, in the sunlight, so that it was scarcely ever necessary to throw out ballast.

M. Balzan in the St. Louis endeavored to avoid the constant falling by ascending to a greater height, but the depth of the clouds was too great to permit the experiment, and the latter cost the unfortunate balloon the greater part of its ballast. Shortly afterward the occupants of the Centaure's car saw the St. Louis slowly approaching earth. The Centaure, on the other hand, rapidly climbed to a height of 4,000 meters, where intense coldness prevailed. The thermometer dropped at an alarming rate as the ship continued to rise until 6,000 meters of space separated it from solid ground.

When the sun appeared on the following morning, the Centaure still kept in an easterly direction, but the aeronauts had completely lost their bearings. Instead of closely grouped villages, huge level plains and wide-spreading forests made up the entire landscape. At length a village appeared under foot, and a Byzantine church told the travelers that they had crossed the German borders and were rapidly traversing the domains of the Czar. A large city loomed up in the distance, and preparations were made to end the long journey.

The descent was made slowly and safely, and the aeronauts found themselves near a wood cutters' camp, whose inhabitants, with amazement written all over their faces, dropped work and crowded round the strange apparition. The travelers were piloted to the home of a nearby estate owner, who understood French, and from whom Count Henry ascertained that he had sailed straight to the city of Kiew, a distance of 2,000 kilometers, 1,300 of which had been made in the record-breaking time of 24 hours, in addition to breaking the record for long distances by about 700 kilometers.

Gathmann Gun Appropriations.

There is a bill before Congress for the granting of an appropriation of $115,000 (making, with a previous appropriation for this gun, a total of about $200,000), for further experiment with the Gathmann gun, for the throwing of high explosives. If this money is voted, it will be wasted in endeavoring to establish certain theories, the falsity of which has been abundantly proved in the past. The Gathmann gun, the Zalinsky gun, the Maxim aerial torpedo gun, and all weapons of this class, are designed upon the theory that if a sufficiently large amount of high explosive can be detonated against or in close proximity to a battleship, the battleship will be, to use the pet term of promoters, annihilated. As a matter of fact, experiments undertaken by the United States government expressly to test this theory have proved that it is absolutely false. On one occasion a Harveyized steel plate, representing the side armor of the United States battleship "Kearsarge," was tested by the detonation of 307 pounds of gun-cotton, which was suspended for the purpose immediately in front of the plate. Instead of being blown into the theoretical "thousands of fragments," the plate was undisturbed, and a slight and harmless scoring on the face of the plate was the only evidence, as far as the armor was concerned, of the explosion. Of four chickens placed either immediately behind the plate, or within from 25 to 50 feet of the gun-cotton, two survived without the slightest sign of being injured; one was killed by a flying fragment of shell (a result which does not affect the argument); and only one appeared to have died from shock. Prof. Alger, the greatest expert in this country, or probably in any country, on this very question, says: "This experiment would seem to completely dispose of the theory that a high-explosive shell of very large capacity will blow in the side of an armored vessel if it exploded against it;" and he further says that "The velocity of the shell would add materially nothing to the effect of a detonation, the rush of whose gases is determined by a pressure of hundreds of tons per square inch."

It is the opinion of Prof. Alger and every ordnance expert the world over, that for a high explosive to be effective it must be carried by the shell through the armor, and burst within the hull of the ship itself. This conclusion was strikingly borne out by the experiments on the "Belleisle," made early in the present year. The high-explosive shells were burst upon contact with the armor, and left no further trace than a harmless star-splash on the outside of the ship.

The system being thus discredited by previous costly experiments made at the expense of the United States government, by what legal or moral right is the country to be asked to provide over one hundred thousand dollars more for the purpose of carrying out further experiments in this direction? If the person or persons who wish to promote this type of weapon have the courage of their convictions, and can interest the necessary capital for prosecuting their researches indefinitely, well and good; but to ask the United States government to distribute public funds for such a purely private enterprise as this, is a procedure which cannot be too strongly condemned.

Prizes for Sugar Machinery.

In our issue for December 8 we called attention to prizes offered by the Honolulu Planters' Association. Our readers will be pleased to know that its officers are located in Honolulu and that its secretary is Mr. C. Bolte. A representative of the association, Mr. Hayward, will arrive in Washington the latter part of January, and from him all the required information can be obtained.

VI. A METALLIC THERMOMETER.

BY GEORGE M. HOPKINS.

A mercurial thermometer calls for manipulations which are not within the scope of the amateur, but require the skill and experience of the regular manufacturer. A metallic thermometer, however, is very easily made, and serves the purpose fully as well as a mercurial thermometer. It can be made as sensitive to the variations of temperature as may be desired.

It is made by placing together a strip of steel and one of brass 6 inches long, ¼ inch wide and 1/16 inch thick. The ends of the strips are tinned for about ⅜ of an inch at each end on their adjacent faces, and then put together and heated first at one end and then at the other, so as to solder them together at the ends.

The brass strip is made about ¼ inch longer than the steel strip, and is bent over and perforated to receive a silk thread as will be presently explained. Commonly, when strips of steel and brass are used in a compound bar, they are riveted at short intervals, to keep them from buckling. In the present case the compound bar is provided with a winding of soft wire (No. 30) which keeps the strips close together. To insure permanency the bars are drilled and riveted with a single rivet at each end.

The compound bar thus made is inserted in a round hole in the middle of a hard-wood block 2½ inches long, and held there by an ordinary wood-screw inserted in the end of the block and clamping the end of the bar. The wooden block is secured to a base piece, 4 inches square and ⅞ inch thick, having attached to it a back board ¼ inch thick, 4 inches wide, and about 10 inches high. A wire nail about 1/16 inch in diameter and 1½ inches long is driven through the back with its pointed end projecting about 1¼ inches. The nail is about ¾ inch from the upper free end of the compound bar. A paper roll is formed upon another nail or a piece of wire a trifle larger than the one used in the construction of the thermometer. The strip of writing paper used for this roller should be 1 inch wide and about 8 inches long. Enough of the paper is wound to make the roller ¼ inch in diameter. The paper, except the first layer, is pasted as it is rolled, so that it forms a solid paper roll when it is dry.

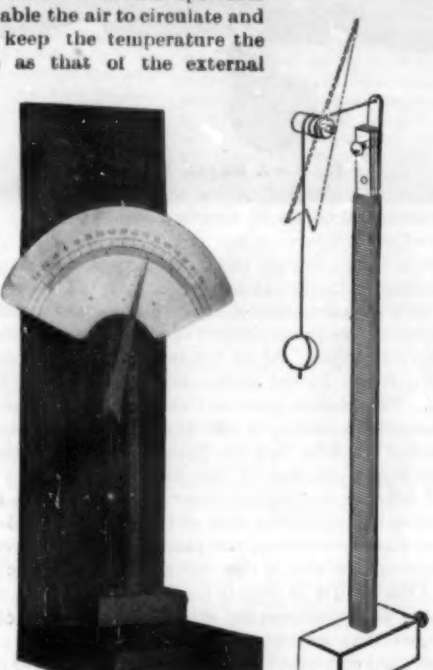
This roll, when dry, is transferred to the nail projecting from the back piece, and a pointer, or index, about 2½ inches long is cut from thick writing paper and glued to the end of the roll. Then a silk thread is tied in the eye in the free end of the compound bar, and passed over the roller on the nail, and wound three times around the roll, and it has attached to it a small weight. In the present case this weight consists of a lead bullet split half open with a knife, and closed down upon the thread by pliers or by hammering. With every change in temperature the compound bar swings, so as to cause a movement of the index by the pulling or releasing of the thread and the raising or lowering of the weight.

The index should be placed in a vertical position when the temperature is about 70°; then the winding of the silk should be separated a little, and a small drop of mucilage should be placed on the middle convolution of the thread at the top of the roller, so as to cement it to the roller and prevent any change of adjustment.

A semicircular piece of bristol board, about 6 inches in diameter, is temporarily supported behind the index by a block glued to the back-piece. The bristol board is to form the thermometer scale and is fastened to the block by tacks or otherwise, so that it can be removed and accurately replaced. A pencil mark is now made on the scale at the point of the index which indicates the temperature as shown by a mercurial thermometer at the time. If it is 70°, the mark on the new scale represents this temperature, and whenever the index points to this mark the observer knows the thermometer is 70°.

Now the thermometer is placed in a refrigerator along with a mercurial thermometer. They are left in the refrigerator for an hour, and then a pencil mark is made at the point of the index. This will, perhaps, be 40°. The space between these two marks is divided into thirty even spaces, representing as many degrees, or it may be divided into fifteen spaces, each of which will represent 2°. This graduated space serves as a guide for constructing the balance of the scale. If 2° spaces are used, twenty such spaces laid off on the left-hand side of the scale will extend the scale to zero. Twenty more such spaces will extend the scale to 40° below zero, which is lower than any temperature experienced in this climate. The space between 40° and 70° is already graduated, and the space above the 70° mark is graduated as described for the lower end of the scale. As each line represents 2°, 10° would be represented by five lines, so that the fifth line could be extended beyond the other lines for the sake of convenience in reading. Figures from 0° are placed opposite the long lines so as to read 10°, 20°, 30°, 40°, and so on, as in an ordinary thermometer scale.

The amateur can refine this thermometer as much as he pleases. He may, if he desires, place the entire device in a case and cover the dial with a glass, provided he furnishes several apertures to enable the air to circulate and thus keep the temperature the same as that of the external air. The free end of the compound bar may have a spring riveted to it, as shown in the detached view, and an adjusting screw may be inserted in the compound bar so as to bear against the spring. With this construction, the silk thread may be tied in a hole in the free end of the spring, and the desired adjustment may be made by turning the screw one way or the other.



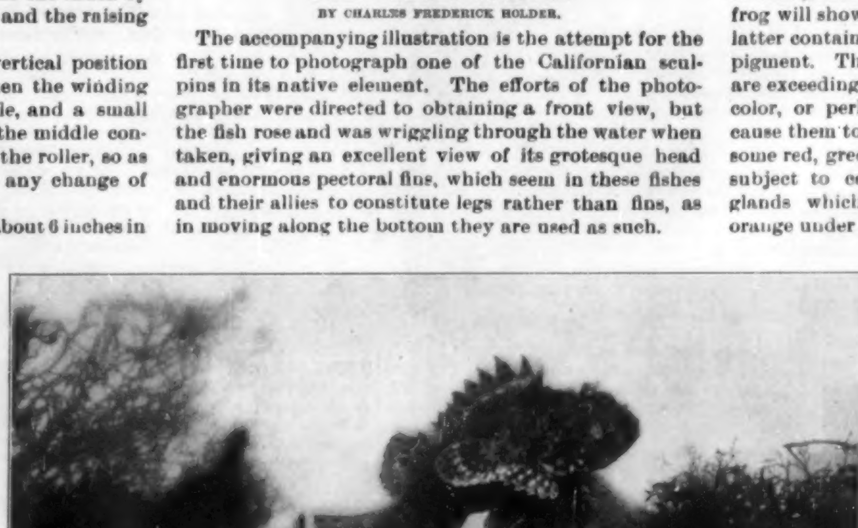
A METALLIC THERMOMETER.

By making the compound bar longer, or diminishing the diameter of the cylinder around which the thread extends, or both, the sensitiveness of the instrument may be greatly increased.

SOME CURIOUS SCULPINS.

BY CHARLES FREDERICK HOLDER.

The accompanying illustration is the attempt for the first time to photograph one of the Californian sculpins in its native element. The efforts of the photographer were directed to obtaining a front view, but the fish rose and was wriggling through the water when taken, giving an excellent view of its grotesque head and enormous pectoral fins, which seem in these fishes and their allies to constitute legs rather than fins, as in moving along the bottom they are used as such.



PHOTOGRAPH FROM LIFE OF A CALIFORNIA SCULPIN.

The sculpin is the common form of the shallows at Santa Catalina Island, and is particularly interesting on account of its marvelous mimicry. The writer kept twenty or more of these fishes in confinement during a period of several months, with the view of testing their power of adapting themselves to their surroundings as a protection. For this purpose several tanks were arranged; one having a white bottom, another one of black, while two others represented various grades between them. Into these the sculpins were liberated. At this time they were all mottled in coloring, white and gray predominating, with here and there a dash of yellow, and when resting on the bottom they were very inconspicuous, and as their habit was to remain perfectly quiet much of the time, it was not always easy to distinguish them. There was one telltale, however—the beautiful eye, which burned and blazed like a topaz in the bright light; and when the sunbeams fell upon the group of sculpins, the bottom seemed to be dotted with gems.

When the sculpins—Scorpæna guttata—were released into the arranged tanks, they all offered a more or less decided contrast, and it was an interesting sight to see them adapt themselves to the new conditions. The sculpins which were released on the white bottom apparently found at once that they were in an unenviable position, presenting a striking contrast to the bottom, with no rocks among which to hide. That the fishes appreciated the situation there could be little doubt, as they moved restlessly about, rising from the bottom with a wriggling motion; and then began the marvelous change which Nature has made possible. They very gradually faded out; no other term expresses it. The distinct dark or black spots became light brown, then gray, then a very light gray, and as I watched them they seemed to melt, as it were, into the sand, becoming less and less conspicuous until finally in an hour or so after they had been placed in the tank they were so indistinct that a few feet away they would have been considered stones instead of fishes. They never assumed a perfectly white disguise, this was apparently impossible; a very light gray or a dirty white was the extent of the effort to assimilate the surroundings, and as a protective movement it was practically a success.

In the fishes which did not offer so great a contrast to their artificial surroundings there was not so marked a change, yet it was more perfect in the sense of being a protection; and in the case of the dark gray and mottled fishes it required a keen eye to distinguish the color of the bodies from that of the surroundings in an hour after the change. Later the sculpins were changed about, the one on the white bottom to a black base, where in time the protective hue was assumed—a defense purely of Nature's designing, which protects the most delicate of animals from their foes. To the average observer it would appear that the fish perceived its danger and proceeded to change its color so that it would become inconspicuous, but that the fish was conscious of the change is far from the truth. The wonderful change in the appearance of the fish took place really without the knowledge of the animal, being due to the color of its surroundings. The term chromatic function is applied to this adaptation of color, and can be better understood by the layman by an examination of the skin of some animal susceptible of change of color. A sectional view of the skin of a frog will show two layers, the epidermis and cutis. The latter contains many large glands filled with color, or pigment. These pigment glands, or chromatophores, are exceedingly sensitive; the slightest change in the color, or perhaps the intensity, of a ray of light will cause them to expand or contract. Some are brown, some red, green, black or yellow, and the colors are subject to certain variation. Heincke found that glands which were yellow when distended became orange under reverse conditions; and cells which were orange, when expanded became black when contracted. Near the epidermis, in the cutis, the investigator will find masses of very light yellow pigment glands. Under them will be seen masses of red or brown, and deeper still layers of jet-black color glands. Exactly how the pigment layers produce such perfect results is difficult to understand, and it is but just to state there are many theories. But certain facts are known which suggest the plausibility of the theory here presented. It has been found that if a complete relaxation of all the chromatophores occurs, the prevailing color of the animal will be black or a very dark brown, depending upon the animal. It was long supposed that light or color rays striking the body of the animal produced the contraction and expansion necessary to change, but finally Pouchet discovered that blind animals remained the same color under all circumstances, which demonstrated that the eye was the medium, these organs receiving the impression, which passes by the sympathetic nerves to the color cells all over the body, causing some to contract, others to expand, so producing a harmonious color scheme in the animal; in a word, producing an assimilation in tint between it and immediate surroundings. No more marvelous page in the book of Nature exists than this, which determines by a most intricate series of changes the protection of innumerable defenseless

forms. The sculpins of the Atlantic seaboard rest under a ban. They are usually thrown away and have no market value, in fact, are never offered for sale. Their extraordinary appearance, horns, barbels, large fiery eyes, strange coloring, all create a prejudice in the minds of the observer. On the Pacific coast, on the contrary, they are highly esteemed, and considered, as they rightly are, one of the most delicate of all the food fishes.

The fish and its allies present an extraordinary range of grotesque forms. All are protected in the same way, and many by strange curious barbels which cause them to still more closely imitate the weed in which they lie and in whose imitation lies their safety.

SOME RECENTLY PATENTED NOVELTIES.

From time to time it is our practice to publish brief illustrated descriptions of patented devices, which, by reason of the exceptional simplicity that characterizes their construction or the rare mechanical skill dis-

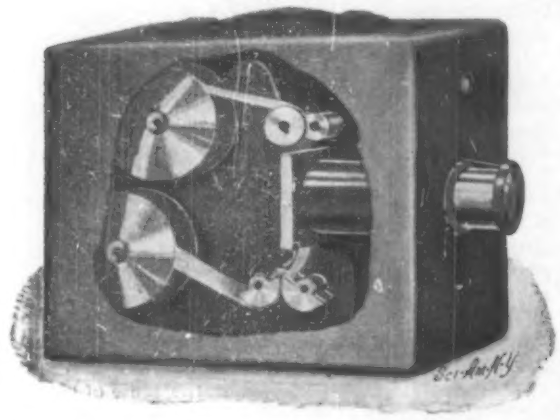


Fig. 1.—IMPROVED FEEDING FOR MOVING PICTURE FILMS.

played by their inventors, have doubtless been found of interest by our readers. We have, therefore, selected a few inventions which, from their novelty or ingenuity, deserve more than a passing notice.

The sensitized film employed in moving-picture cameras is usually perforated along its edges and is fed by catch-hooks or revolving pin-wheels which engage the holes in the strip. Sometimes these holes are torn out, and sometimes they fail to catch the feeding pins. The negative produced is thereby distorted and perhaps destroyed. In an invention patented by William V. Esmond, the strip is not perforated, and is not fed by the ordinary means. From the main reel the film passes between two guide-rollers downward upon a

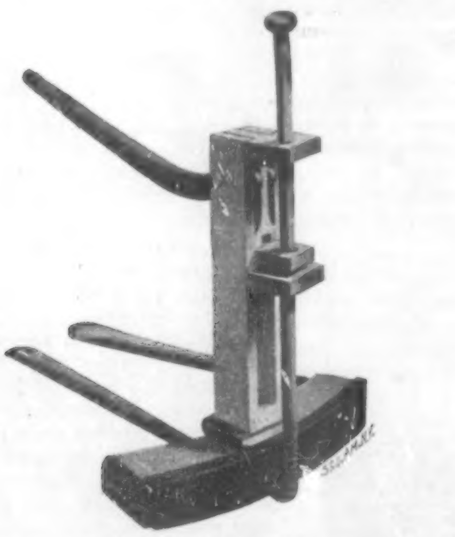


Fig. 3.—TIRE-REMOVER.

sustainer-plate, which is mounted in the focal plane and which serves the purpose of keeping the film smoothly extended during the period of exposure. The film is fed by mutilated rolls, which bite and advance the interposed strip only during the period when the unmutilated or full portions of the rolls confront each other. The feed-rolls and shutter of the camera are driven in unison.

In order easily to remove tires from wheels, Mr. Bradford M. Buckland has invented the tire-remover shown in Fig. 3. Between two posts, mounted on a base plate, a lever is journaled, the outer forked end of which, through the medium of a link, is connected with a clutch. Through an opening in the clutch a rod passes, the lower end of which is bent. The wheel is laid flat upon the hub; the device is placed on the felly; the lower bent end of the rod is made to engage the edge of the tire, as shown in the illustration; the lever is forced down, and the clutch is made to grip the rod and lift the tire as the lever is depressed.

Our third illustration represents a wrench provided with novel means for adjusting the jaws to the nut to be turned. The jaws slide on a central rod inclosed in a sleeve and provided at its ends with screws which coact with the jaws. The screws are fitted with handles. From the sleeve a spindle projects, upon which a handle is swiveled. The swiveled handle is held in

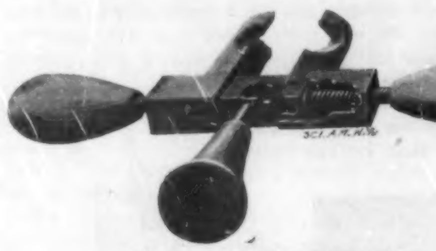


Fig. 2.—A NOVEL WRENCH.

one hand, and either of the other handles is turned, so as to adjust the jaws to the nut. The handles on the screws are used to turn the wrench upon the swiveled connection with the other handle.

A very simple means of extinguishing the candles of Christmas trees is the subject of an invention patented by Martin Hagan. At its upper end the candle carries a plate, which moves downwardly as the wax burns away. The plate is provided with a doubly-bent arm, each member having a slot through which a vertical guide-rod extends, forming part of the candle holder. To the upper member of the doubly-bent arm a combined reflector and extinguisher is hooked which has a downwardly projecting arm sliding on the guide-rod. As the wax burns away, the plate on the candle moves down, carrying with it the reflector and extinguisher. When the candle is nearly burnt away, the arm of the reflector and extinguisher strikes the bottom of the guide, so that as the candle-plate moves down still further, the combined reflector and extinguisher drops on the wick. The hooked upper end of the guide-rod serves the purpose of carrying a shield to prevent the flame from igniting the upper branches of the Christmas tree.

Fig. 5 explains itself. The back-piece and base, which constitute the shelf there pictured, are each provided with a series of holes which receive the downwardly bent ends of wires serving as partitions. It is

Fig. 4.—A COMBINED REFLECTOR AND EXTINGUISHER FOR CHRISTMAS-TREE CANDLES.

evident that the wire can be made to divide the shelf into spaces of any desired size.

The last of the inventions illustrated is a process of puddling iron, devised by Mr. James P. Roe. The molten metal has, as a general rule, been agitated by hand, entailing the most exhausting labor on the part of the puddler. In this invention pig-iron is converted into wrought-iron by causing a mixed charge of molten cast-iron and cinder to flow back and forth in the presence of hot gases, and by abruptly arresting the flow of the charge before each change in direction until the iron comes to nature. The oscillation and the abrupt stoppages are continued until the particles of purified iron are compressed and solidified. In carrying out the process, a hearth is employed which is provided at each end with a chimney, and is rocked by a rack and pinion mechanism, so that the iron and cinder can flow by their own weight from end to end of the hearth.

Harmless Sugar Colors.

The following receipts, says Deutsche Drogisten Zeitung, do not conflict with the food law, and give very handsome colors for sweetmeats and other edibles.

Red.—Mix cochineal, burnt alum and purified potash, 1 part each, and cream of tartar, 2 parts, all finely powdered. Grind with water according to need and concentration, let stand alone for some hours with stirring, and filter.

Blue.—Indigo carmine in pulp and enough water to obtain the desired shade.

Yellow.—Saffron 1:10 diluted spirit of wine — 0·7+3. Treat the saffron after the pressing once more with diluted spirit of wine, 5, and mix both extracts. For cheaper sweatmeats—tincture of turmeric, 1:5.

Green.—Mix yellow and blue.

Orange.—Mix yellow and red.

Also, aniline colors free from arsenic.

The Builders of Our New Battleships and Cruisers.

The Board of Construction has recommended the distribution of contracts for battleships and armored

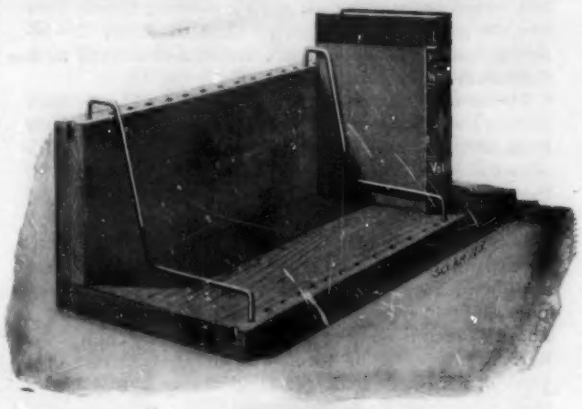


Fig. 5.—A DIVISIBLE BOOK-SHELF.

cruisers among the shipyards of the country, as follows: Fore River Engine Company, Quincy, Mass., two unsheathed battleships for $6,810,000; William Cramp & Sons, Philadelphia, Pa., one sheathed battleship, one sheathed armored cruiser, and one unsheathed armored cruiser, $11,270,000; the Newport News Company, of Newport News, Va., one sheathed battleship, one sheathed armored cruiser, and one unsheathed armored cruiser, for $11,258,000; the Bath Iron Works, Bath, Me., one sheathed battleship, $3,590,000; Union Iron Works, of San Francisco, Cal., one sheathed armored and one unsheathed armored cruiser, for a total contract price of $7,550,000.

The Current Supplement.

The current SUPPLEMENT, No. 1304, is very interesting. "The Looting of the Pekin Observatory" is accompanied by a number of illustrations of the bronze

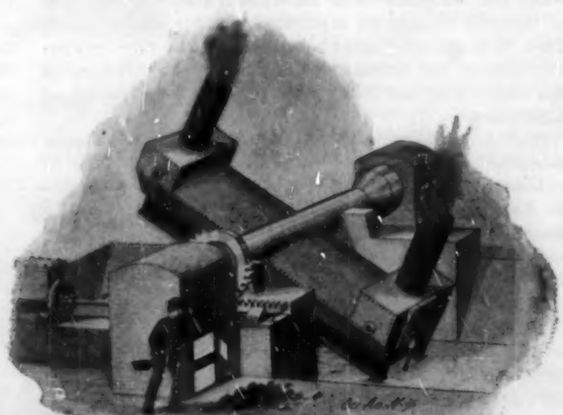


Fig. 6.—OSCILLATING HEARTH.

astronomical instruments of the thirteenth and seventeenth centuries. "Recent Discoveries in Crete" describes the uncovering of the "Ancient House of Minos." "New and Simple Method of Making Telescopic Objectives" is continued and is accompanied by working drawings. "French Locomotives at the Exposition of 1900" is continued and is accompanied by a number of engravings. "Wireless Telegraphy" describes the Popoff, Righi and Marconi devices.

Contents.

(Illustrated articles are marked with an asterisk.)

RECENTLY PATENTED INVENTIONS.

Electrical Apparatus.

BLASTING.—CALEB F. BRYANT and CHARLES H. BROWN, Cripple Creek, Colo. The blasting device is provided with a fuse and with a primary igniting device for the fuse comprising a shell engaged by the fuse. Terminals forming part of an electric current, extend into the shell. A disk of tin-foil connects the terminals. Combustible material is arranged between the disk and the fuse. By means of the device, the reports can be successively counted; and if one charge has not exploded the operator knows which one of the charges has not exploded. By using tin-foil as a partial conductor for the current, a positive ignition is always insured; and more primary igniters can be set off at the same time by an electric current of a given strength than would otherwise be possible.

CIRCUIT-BREAKER.—GEORGE W. PARSONS, La Grange, Ill.—This circuit-breaker is designed in addition to being opened and closed manually, to be automatically opened either instantaneously upon an overload of current. When the overload is not immediately dangerous the circuit will be opened only after the lapse of a reasonable time. During this interval an alarm is sounded, giving ample warning to reduce this overload before the circuit could be opened by the continuance of the overload to the expiration of the time limit.

Engineering Improvements.

ENGINE.—JACOB E. HARTWELL, Troy, Mont. The invention relates to engines working by internal combustion or explosion, and has for its object to increase the power of such engines, and to provide at the same time improved means for cooling the explosion-chamber and adjacent parts of the engine. This result is obtained by the injection of water, which not only has a cooling effect, but by the generation of steam increases the motive power of the engine.

ROTARY-ENGINE.—BENJAMIN F. LAZENBY, Wentworth, Mo. This rotary engine is provided with a revolving piston having two annular steam-spaces and with two piston heads, related, respectively, to such spaces. These parts work with a peculiar valve mechanism shifting the steam alternately from one steam-space to the other, whereby the piston is caused to rotate continuously.

BOILER-FEEDER.—HENRY J. DAVIS, PLAYFAIR J. AULT, WILBER W. BAILEY, and JAMES WIDENER, Birmingham, Ala. The water is automatically admitted to the machine by gravity at a time when the connections with the boiler are closed automatically. When the water-tank employed is filled, the water is automatically cut-off and the boiler connections at the same instant open, both top and bottom. The water in the tank when full standing at a considerably higher level than that in the boiler and the pressure being equalized, the water naturally falls into the boiler until the level is the same as in the tank. The boiler connections being then again automatically closed, the water connection is opened and the operation is repeated. When the tank has discharged its water into the boiler, it is full of steam at boiler-pressure. This pressure is automatically relieved at the same instant the boiler connections are closed and the exhaust-steam is conveyed to a condensing-tank, whereby the water therein is heated before discharging into the water-tank.

Motor-Vehicles.

MOTOR-PLOW.—FRANK P. FELTER, Haverstraw, N. Y. On a carriage a motor is mounted. Underneath the rear portion of the carriage plows are arranged, the beams of which are connected by links with the platform. A bar connects the beams of opposite plows. Curved rods are extended upward from the beams at their rear ends; and these rods pass through guide-tubes attached to the platform. Mechanism is connected with the cross-bar for raising and lowering the plows.

GEARING.—EDWARD R. BALES, Centralia, Ill. The invention provides a gearing adapted especially to automobiles, the object being to provide means for transmitting the driving power from the motor to the traction axle, which means will not be influenced by the movement of the vehicle-body independently of the driving-axle.

Mechanical Devices.

SNOW-MELTING MACHINE.—EDWARD BEATTY, Brooklyn, New York city. This snow-melting machine has a snow-melting box or tank provided with a top overflow whereby the tank is kept full of water. The products of combustion from a furnace are forced into the water in the tank at a point below the overflow, thereby keeping the water heated and quickly melting the snow placed in the tank. The machine is designed for use in cities and is arranged to be conveniently moved along the streets and to discharge the melted snow directly into the sewer.

EMBROIDERING ATTACHMENT FOR SEWING-MACHINES.—JOSEPH GRUBMAN, Brooklyn, New York city. The inventor has devised a new attachment for Bonnaz or other embroidering or sewing machines, which attachment is arranged to intertwine or otherwise arrange embroidering materials, such as braid, chenille, tapes, cords, bands, or the like, upon the fabric to be embroidered. An intermittent swinging motion is given to two carriers so that they alternately cross their embroidering materials and form intertwining loops secured in place on the fabric by stitches.

CLAY SCREENING-APPARATUS.—HORACE G. VIRGIN, Penrith, W. Va. Mr. Virgin has invented an ingenious means for screening clay used in brickmaking. His machine comprises an inclined screen with a brush or a gang of brushes arranged therein and connected with means for reciprocating them on the screen, so that the fine clay is sieved therethrough and the lumps of coarse clay are caused to gravitate down the screen into a suitable receptacle at its lower end.

CHERRY-PITTER.—EDWARD H. SKINNER, Springbrook, Ore. The object of this invention is to produce a device which shall pit cherries and similar fruit in large quantities. The device can be economically used for pitting fruit to be canned on a commercial scale. An endless belt has a series of pivoted plates which are adapted to turn on the pivots as the belt makes a turn at one end. The plates are provided with apertures designed to receive the fruit. As the plates turn, the cherries are jarred free; and a number of pitting-rods or pins are caused to pass through the apertures in the plates in order to remove the pits from the cherries.

DRILLING-MACHINE.—HANS O. NIERSTAEDT, Copenhagen, Denmark. Hand-power drilling-machines are subject to the disadvantage that the velocities of their flywheels are not variable. All such machines work with the same flywheel velocity whether small or large holes are to be drilled; and as the driving-crank is rotated more quickly when a small hole is being drilled than when a large hole is being drilled, the flywheel speed is too high in the one case and too low in the other. In order to overcome this difficulty, the flywheel of the machine forming the subject of this invention is applied to the drilling-spindle, so that change-gear can be applied to the intermediate shaft. By these means, revolutions of the driving-crank can be so transmitted to the flywheel that the velocity when the crank is turned at its normal speed can be increased when drilling large holes and reduced when drilling small holes.

Railway Appliances.

CAR STARTER.—THOMAS GERAGHTY, Bayonne, N. J. This device is, in the nature of a crowbar, especially adapted for starting freight-cars and is so constructed that it is simple, light, and readily transportable. The device consists primarily of three parts: a lower bar section, a socket in which the bar enters, and a handle which enters the socket and engages the bar-section.

CAR-COUPLING ATTACHMENT.—THOMAS P. SMYTH, Pocatello, Idaho. It is the purpose of this invention to provide means for preventing the fall of the coupler, should it for any reason become detached from the car on which it is mounted, and also to prevent the loss of the knuckle or breakage of the coupler. Ordinarily both of these disadvantages are frequently noticeable; and the present invention comprehends a simple attachment which will prevent the failing of the coupler and prevent the breakage of the pivot-pin of the jaw. A rigid hanger is extended under the coupler for the purpose of preventing the falling of a mating coupler. A support is designed to receive the lower end of the pivot-pin of the coupler-jaw to prevent the fall of the pin when it becomes fractured.

OPERATING RAILWAY-SWITCHES.—AMOS YOUNGBLOOD, North Augusta, S. C. In this railway-switch tongues are connected with a bar formed with a projection near one end. A bell-crank lever has one arm arranged for engagement with the projection to move the bar in one direction. A forwardly spring-pressed slidable rod is connected with the other arm of the lever, and a lever is fulcrumed in the siding and is arranged for engagement by the rolling stock. The lever is connected with the rear end of the slidable rod. The switch is automatically operated by the railway rolling stock. Its setting is always properly insured, whereby the possibility of a wreck on account of an open or misplaced switch is precluded.

Miscellaneous Inventions.

FRUIT-GATHERING BAG.—GEORGE W. BOWMAN, Palisade, Colo. In order that the hands may be free to pick the fruit, the inventor hangs the bag from the neck of the fruit-picker. The bag is convenient in use, is adjustable in length; so that fruit placed therein need not be dropped and bruised; is adapted for change in position on the person of the fruit-picker; and affords means for the quick discharge of the fruit without injury.

SCRAPER.—CHARLES A. SUTTON, Pitkin, Colo. This one-piece scraper has a number of scraping-surfaces which may be readily restored to good condition when worn. The device is so shaped and its scraping-surfaces so arranged that it may be conveniently applied to remove the matter which collects on pots, pans, kettles, and their handles, no matter what shape the bodies or handles may be. The scraper can also be used as a crumb-collector or for cleaning or scraping floors, wainscoting, or the like.

PRINTING APPARATUS.—CAROLINE MONTEITH, Manhattan, New York city. The object of the invention is to provide a new and improved apparatus for kindergarten and school use and for the preparation of bulletins, charts, and the like. The apparatus is provided with a guideway having longitudinal parallel members extending over or in front of the paper to be printed on. A type-holder and spacer is movable on the guideway, to guide a type-block between the members of the guideway to the paper in order to make an impression. The holder has a type-receiving opening with a continuous surrounding wall.

COIN-HOLDER.—THOMAS O. MILLER, Houston, Tex. The coin-holder comprises a tube in which a coil-spring is arranged. Spring-catches secured to the upper end of the tube extend upon the top of the uppermost coin to hold the coins in place in the tube and to permit the operator to slide the uppermost coin forwardly out from under the catches and away from the tube. The under sides of the catches are a distance above the upper edge of the tube. The coin-holder is designed for use on a belt or on a stand placed on a counter or desk. Several holders are to be provided to receive coins of desired denominations. By means of this device, change can be quickly made.

DISK-SHARPENER.—MARTIN J. LOHRBACH, Peotone, Ill. This invention relates to means for manually sharpening the cutting edges of harrow or plow-disks while they are in place on their supporting-shaft. The disk is supported by a post which carries a bracket in which a cutter is held. One man grasps the post, and another, by means of a specially-constructed crank-handle, turns the disk so that it can be sharpened by the cutter. This disk-sharpening device is very simple, is cheaply manufactured, and is very efficient in operation.

METHOD OF MAKING WHEELS.—JOHN T. KELLEY, New London, Ohio. The purpose of this invention is to cheapen the work of producing metallic wheels, both in respect to labor and cost of materials, to which end the invention consists in forming the wheel from metal sheets. A sheet of metal is slit at opposite ends to form strips and an unbroken middle portion. The sheet is rolled into the form of a tube; and the strips are bent out radially to form the web or spokes of the wheel. The hub is formed of the unbroken middle portion of the sheet of metal.

POCKET-FILTER.—AUGUSTA M. HAMILTON, Medindie, 12 Robe Terrace, South Australia. The invention is especially designed to be applied to the canvas water-bag carried by troops in war and by bushmen. The filter comprises essentially a carbon block permanently secured within a ring of metal, having a cap secured on each end of the ring, forming a chamber on each side of the carbon block. Each chamber having a pipe connected therewith, one forming the inlet and the other the outlet.

JAR-CLOSURE.—FRANK M. WEIR, Monmouth, Ill. The cover of the jar has longitudinally-curved recesses in its upper surface, in which recesses a curved spring-plate has its ends movably engaged. A bail is mounted to swing on the vessel and is adapted to engage the spring-plate. The closure is of simple construction, so that it can be quickly and easily attached and detached.

ACETYLENE GAS APPARATUS.—FREDERICK METZGER, Hondo, Tex. The machine comprises a body portion in which a bell is arranged. A pipe extends down one side of the body portion to communicate with the top of the body portion. In a cylinder arranged within the body portion a pipe leads from the body portion. A guide-rod is attached to the bell and is extended in the pipe. To the pipe a blow-off is secured. A pipe is fixed to the body portion; and in this pipe the outer member of the blow-off pipe is movable, thus forming a guide for the bell. The carbid holder is located in the cylinder. Gas discharge pipes and valve-controlling mechanism are provided. With this machine, the inventor states there can be no loss or leakage of gas. Before passing to the distributing pipe the gas will be thoroughly washed and the coal tar run off.

BOOT OR SHOE.—MICHAEL HALLANAN, Manhattan, New York city. The purpose of the invention is to provide a yielding treading surface for boots and shoes in order to relieve the wearer of jar and concussion. The invention comprises a member forming a yielding tread—for example, a rubber heel—which is so constructed that it cannot only yield to the weight of the wearer, but also expel a certain volume of air at each step and draw in fresh air around the top of the shoe.

HOLDBACK AND SHORT-HITCH.—GEORGE BOUSLOG, Winamac, Ind. The invention relates to an attachment of vehicle thills by which to facilitate the connection of the holdback strap. A bar or body is provided with an undercut groove in which a keeper is slidingly mounted. A holdback is mounted on the bar or body adjacent to the groove. Means extend between the holdback and the keeper to engage the holdback with the inner walls of the undercut groove whereby adjustably to fasten the holdback on the bar or body.

RECEIVER FOR FOLDED PAPER BAGS.—JOHN CARLEN, Havanna, N. D. The device is capable of receiving folded paper bags of any size and of sustaining the bags so that they will be kept smoothly lying one upon the other, and so that only one bag can be withdrawn at a time. The bottom folded portions of the bags serve as a medium through which the bags may be grasped to facilitate their withdrawal. Roller weights, provided for holding the bags in position, automatically accommodate themselves to the thickness of the package of bags or to the thickness of a single bag contained in the device.

ENVELOP.—SPENCER CLAWSON, Salt Lake City, Utah. The inventor constructs envelops in continuous sheets so as to save material and to place the envelope on the market in connected form. The continuous sheets are provided with score lines between the envelops to to facilitate their detachment.

HANGER FOR PICTURE FRAMES.—PETER DOBLE, Centreville, Mont. The hanger is so constructed that it can be made from one piece of wire and include means for ready attachment to the screw eyes or loops of a frame. Means are provided for steadying the frame; and also means whereby the hanger may be supported from a molding or bar, or from a nail or like article.

PROCESS OF MAKING ARTIFICIAL SILK THREAD.—JULES DUQUESNOY, Avenue Kléber 14, Paris, France. The inventor has devised a new solvent of nitrocellulose or gun cotton used in the making of artificial silk. The solvent consists of acetone, acetic acid, and amyl alcohol. By the use of this solvent an artificial silk is obtained which in quality it is said surpasses that hitherto produced.

KNEE OR ELBOW CAP.—FRANK W. GORSE, Highlandville, Mass. The invention provides an elastic tubular bandage comprising a front piece and a rear piece. The side edges of the rear piece are shorter than the side edges of the front pieces; and the pieces are fastened together at the side edges. The rear piece has its upper and lower portions formed with elastic warp threads. The middle portion is in the form of a fine, loose weave of elastic threads. By reason of this fine loose weave the skin is not liable to be irritated at the joint of the knee or elbow. The member to which the bandage is applied can be bent without undue binding of the flesh at the joint. The middle portion readily forms into folds or wrinkles corresponding with those of the skin, and consequently irritation is entirely prevented.

FILTER.—ARTHUR G. GRENAMYER and GEORGE A. ROBINSON, Leetonia, Ohio. The filter comprises a tank into the upper portion of which a basket is extended having a flange portion projected upon the top of the tank. A packing or gasket is arranged between the flange and the top; and a vacuum regulator is connected with the tank. In this filter the material is rapidly refined. The construction is cheap and simple. The parts may be thoroughly and rapidly cleaned. The vacuum serves the purpose of preventing the material from overflowing the basket, for it will be forced out of the basket as rapidly as poured in. Indeed, the filter will work as fast as oil and water will separate.

SPRAYING APPARATUS.—JOHN J. COUGHLIN, Bradford, Ohio. This invention is an apparatus adapted especially for spraying trees, shrubbery, and the like. The apparatus comprises a liquid reservoir and an air reservoir, the two being separable and provided with means for removably engaging them, so that they may be carried about on a cart. The air reservoir has a pump and communicates with the liquid reservoir by means of a flexible tube.

LADDER.—LUITJEN J. R. DE VRIES, Panola, Ill. It is the purpose of this invention to provide a new step ladder which is designed for use in fruit packing, washing, painting, scrubbing, and other purposes. The ladder is provided with a shelf stick on which a shelf is pivoted. A supporting and adjusting device carried on the leg of the ladder receives the shelf stick to adjust the shelf up or down, or to swing the shelf into an angular side wise position. The device in question comprises a disk having grooves secured to the leg of the ladder; and a socket mounted to turn on the disk and carrying two cam levers, one of which is adapted to engage the stick, and the other of which is adapted to lock the socket to the disk. By reason of this construction one can reach a large area at each adjustment. Baskets, pails or other receptacles can be supported within convenient reach.

LAMP-SHADE OR GLOBE.—WILLIAM L. STRACHAN, 88 St. James Street, London, England. A light reflecting and diffusing medium is the subject of this invention. A spirally-wound rod of glass of hemispherical or bowl shape, hermetically inclosed between inner and outer walls of translucent glass is the reflecting medium. The rod is protected from injury in handling the shade and is shielded from the accumulation of dust.

DOUGH-MIXER.—JAMES F. STEVENS, Port Chester, N. Y. By means of this mixer the dough is quickly kneaded and finally converted into a practically round mass which, after the dough has been fermented, may be lifted by the mixing agent from the receptacle in which it is kneaded and transferred to another pan, or to a moulding board, without leaving any particles of dough behind in the vessel or on the mixer. The device can be also used as a sifter for flour. The flour is discharged in the botton of the main receptacle so as to form a central depression in which water may be poured. Or the flour may be sifted and the dough mixed at the same time. As it leaves the sieve more rapidly than the dough is mixed, the flour will be kept within the mixing-dough and the sides of the pan.

PAPER-FILE.—FRANCIS J. MCDONNELL, New Bedford, Mass. The paper-file has a fixed document-holder upon which a document is guided by a spindle. A guard for the documents is placed on the file, which guard is controlled by the spindle. When the spindle is pressed, the guard moves out of an active position; and when the pressure on the spindle is released, the guard moves back into an active position.

Designs.

COAT-FORM.—WILLIS L. JOHNSON, Seymour, Ind. This patent is for a coat-form for use in exhibiting coats. The form is provided with a projecting flange or lip forming a neck portion and with a flat crown portion coinciding with the arm-hole of the coat.

BELT.—JOHN STEMBER, Manhattan, New York city. The belt has an ornamental front panel embossed on its body, so that a pointed center and side members are presented, which curve upward from the pointed center. Button-like ornaments are arranged longitudinally on the side members of the panel.

PEN, PENCIL, AND INK-HOLDER.—EMILE BICK, 521 Seventh Street, Buffalo, N. Y. This novel design embodies, as its main feature, a frying or stew-pan whose body is provided with notches adapted to receive and hold a pen or pencil. The stew-pan is to be suspended vertically by its handle. A socket for an ink-stand is provided on the lower side of the rim. A thermometer and a weather indicator or barometer are arranged vertically on the bottom of the pan; and between them a calendar is located. The pictures of a bison's head and two small stew-pans are located above the calendar.

NOTE.—Copies of any of these patents can be furnished by Munn & Co. for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

NEW BOOKS, ETC.

STREET PAVEMENTS AND PAVING MATERIALS. A Manual of City Pavements. The Methods and Materials of their Construction. For the Use of the Student, Engineers and City Officials. By George W. Tillson, C.E. New York: John Wiley & Sons. 1900. 8vo. Pp. 544. Price $1.

The literature relating to paving is quite extensive, but there is ample room for a work of sterling worth like the volume before us. The history and development of pavements, stone, earth, brick, cement, concrete, cobble stone, block pavements, wood pavements, broken stone pavements, the construction of street car tracks in paved streets, the width of streets, etc., all are treated in an adequate manner.

TECHNOLOGISCHES LEXIKON. Handbuch fuer alle Industrien und Gewerbe. Redigirt von Louis Edgar Andés. Illustrated. Parts 6 to 10. Vienna: A. Hartleben. 1900. Large octavo. Price per part, 25 cents.

THEORY AND CALCULATION OF THE ALTERNATING CURRENT PHENOMENA. By Charles P. Steinmetz, with the assistance of Ernst J. Berg. New York: Electrical World and Engineer. 1900. 8vo. Pp. 525. Price $4.

This is the first work ever written in any language dealing in a complete and logical manner with all the phenomena of alternating currents in the designing of alternating current machinery. The work contains the very latest knowledge relating to alternating current phenomena as applied in engineering, much of which is original with the author, and here appears for the first time in book form. The eminent authority of the author and the original methods he pursues have assigned to this work a high place in electrical literature, in which it takes rank as a classic. The present is the

third edition, revised and enlarged. It is well illustrated by diagrams and there are many tables.

ENAMELS AND ENAMELING. By Paul Randau. London: Scott Greenwood & Company. New York: D. Van Nostrand Company. 1900. 8vo. Pp. 188. Price $4.

The book is intended as an introduction to the preparation and application of all kinds of enamels for technical and artistic purposes for enamel makers, workers in gold and silver and manufacturers of objects of art. Until recently the literature on enameling was neglected, but with this book and the one by Cunynghame the field seems to be adequately covered. The directions are straight-forward and the formulas appear to be excellent. It is a book which can be safely recommended.

STUDIES FROM THE YALE PSYCHOLOGICAL LABORATORY. Edited by Edward W. Scripture, Ph.D. Researches in Experimental Phonetics. Observations on Rhythmic Action. By E. W. Scripture. Vol. VII. 1899. Octavo. Price $1.

Dr. Scripture has opened up an entirely new field in psychological research. He has critically studied talking machine records of English poetry, and has shown us that if our concepts of the elementary sounds of language are not altogether wrong, they certainly need revision. It is the opinion of Dr. Scripture that "the correct concept of the English poetical line seems to be that of a certain quantity of speech-sound distributed so as to produce an effect equivalent to that of a certain number of points of emphasis at definite intervals." Our very limited space prohibits an extensive review of Dr. Scripture's work.

DYNAMO-ELECTRIC MACHINERY. Its Construction, Design and Operation. Direct Current Machines. By Samuel Sheldon, A.M., Ph.D., assisted by Hobart Mason, B.S. New York: D. Van Nostrand Company. 1900. 12mo. Pp. 281. Price $2.50 net.

The book is intended to be used primarily in connection with instruction in electrical engineering institutions for technical education. It is intended equally as much for the general reader who is looking for information concerning dynamo-electric machinery, of types discussed, as well as a book of reference for engineers. The author is Professor of Physics and Electrical Engineering in the Polytechnic Institute in Brooklyn, and has been very successful as a teacher and a lecturer. He has produced a most excellent book.

IRON CORROSION. ANTI-FOULING AND ANTI-CORROSIVE PAINTS. By Lewis Edgar Andes. London: Scott Greenwood & Company. New York: D. Van Nostrand & Company. 1900. 8vo. Pp. 275. Price $4.

There is no more important subject with which the civil and mechanical engineer has to deal than corrosion of iron and steel and the methods of preventing it. The author has done a signal service in preparing such a comprehensive work upon the subject. It is a unique contribution to technical literature, and is a work which we can heartily commend to all who are in any way engaged in building iron and steel structures.

THE TESTING AND VALUATION OF RAW MATERIALS USED IN PAINT AND COLOR MANUFACTURE. By W. W. Jones, F.C.S. London: Scott Greenwood & Company. New York: D. Van Nostrand Company. 1900. 16mo. Pp. 88. Price $2 net.

This little text-book is intended to supplement the larger and more comprehensive works on the subject, says the Preface, but at the same time it is filled with most valuable matter, which interests all who are in any way connected with the paint manufacturing industry. The various processes given have been selected from numbers of others after many years of experience.

PREPARING FOR INDICATION. Practical Hints. By Robert Grimshaw. Second edition. New York: Practical Publishing Company. 1900. 18mo. Pp. 56. Price $1.

Nothing is more annoying than for a mechanical engineer to reach a plant, possibly far out in the country, and find that the engine has to be drilled and the pipe attached. The author prepared the little book before us in order to obviate difficulties of this kind, and to show how necessary connections should be made.

INTELLIGENCE IN PLANTS AND ANIMALS. By Thomas G. Gentry, Sc.D. New York: Doubleday, Page & Company. 1900. 8vo. Pp. 489. Price $2 net.

The present volume is a new edition of the author's privately printed "Soul and Immortality" and is filled with most interesting animal stories. It is unusually impressive, being a collection of strange and curious facts from the life of animals and plants which seem to bear out Mr. Gentry's claim for them of a much higher order of intelligence than is generally allowed them.

TEXT BOOK OF IMPORTANT MINERALS AND ROCKS. WITH TABLES FOR THE DETERMINATION OF MINERALS. By S. E. Tillman. New York: John Wiley & Sons. 1900. 8vo. Pp. 176. Price $2.

This book is a slow outgrowth of efforts to meet the necessities of the United States Military Academy for a convenient text book of important minerals and rocks. The author has performed a difficult task in a very acceptable manner. The tables are excellent, and tend to afford a ready determination of rocks.

Business and Personal.

Notes & Queries

HINTS TO CORRESPONDENTS.

Names and Address must accompany all letters or no attention will be paid thereto. This is for our information and not for publication.
References to former articles or answers should give date of paper and page or number of question.
Inquiries not answered in reasonable time should be repeated; correspondents will bear in mind that some answers require not a little research, and, though we endeavor to reply to all either by letter or in this department, each must take his turn.
Buyers wishing to purchase any article not advertised in our columns will be furnished with addresses of houses manufacturing or carrying the same.
Special Written Information on matters of personal rather than general interest cannot be expected without remuneration.
Scientific American Supplements referred to may be had at the office. Price 10 cents each.
Books referred to promptly supplied on receipt of price.
Minerals sent for examination should be distinctly marked or labeled.

(8012) C. H. H. asks: 1. Could you give me a receipt for transferring newspaper or other pictures in which printer's ink is used, the same as letter copying is done? A. Dissolve a stick of caustic potash in 20 fluid ounces of water. Wet the printed matter with it, blot off the excess of water, apply plain uncalendered paper and rub with a hard object. 2. Can I use copper-plated sheet iron in an acetylene gas holder? Would there be any chemical action caused by the gas? A. We do not recommend copper in an acetylene generator. Under certain conditions it may cause an explosive compound to be generated. 3. Is there only one factory in the United States for the manufacture of carbide for making acetylene? A. We believe there is only one. 4. Is there any way of obtaining a fair quality of lubricating oil from petroleum, having an asphaltum basis, without distillation? A. Petroleum and asphalt may make a good tar lubricant for axles or other heavy machinery. We cannot suggest a method of manufacture.

(8013) I. H. M. asks: 1. Wish to build a small dynamo about ¼ horse power (4-pole type preferred). Can you give me dimensions? Have you a SUPPLEMENT describing such a machine? A. See SCIENTIFIC AMERICAN, vol. 77, No. 11, price ten cents. 2. Is the current of an induction coil direct or alternating? A. An induction coil gives an interrupted current. By the construction of the coil the current in the secondary which would be produced by the closing of the primary circuit is suppressed, that is, it does not produce any spark. The spark is produced only when the primary circuit is broken, hence the sparks are all in the same direction. 3. Have you a SUPPLEMENT giving description of an alternating current motor? A. No, except the one referred to in answer above. 4. Can the small alternating dynamos used in telephones be changed to direct by changing armature connections? A. Yes, by putting a commutator upon the armature in place of the rings which take off the current. 5. Would it be practicable to build a small 4-pole dynamo with changeable connections, making it both direct and alternating, for experimental work? A. It would be better to build it with a commutator at one end of the armature shaft and the rings at the other, or else with both side by side at the same end. Then connect the wires to either pair of brushes as you please.

(8014) I. C. T. asks: Is permanent magnetism limited? A. No; magnetism is not limited, but the capacity of steel to receive it is limited. 2. What weight in soft iron would a permanent magnet weighing 100 pounds, magnetized as strong as possible, sustain? A. We do not know. Heavy magnets do not support so large loads relatively as lighter ones do. A 1 pound Haarlem magnet has, it is said, supported 28 pounds. A 3½ pound Haarlem magnet has held up 62 pounds. These are extraordinary results, which have not been equaled elsewhere. See Thompson's "Electromagnet," $6 by mail. A 100 pound laminated magnet might hold up 100 to 150 pounds. 3. With 550 volts how many amperes would it require to run a 1,000 horse power motor? A. About 1,500 amperes. 4. Can electric currents of different voltage and different amperage be mixed together? A. Yes; but it would not be a nice thing to do if there was any great variety in the voltages. 5. What is the least voltage and least number of amperes required to run a ⅛ horse power motor? A. With allowance for losses ⅛ horse power is about 100 watts. You can divide this up as you please. If your current pressure is 10 volts, 10 amperes are required; if 100 volts, 1 ampere is required.

(8015) G. K. D. writes: I wish to make a so-called solar microscope for exhibition purposes. If you can aid me in this matter, I shall feel very thankful to you. A. The solar microscope is a very simple piece of apparatus. It consists of a mirror outside the window of a darkened room, usually fastened to the shutter through a hole in which the beam of light is reflected by the mirror. The light then passes through a condensing lens of 4 or 5 inches in diameter and with a focal length of 9 inches. The objective of the microscope is placed near the focus of this condenser. The object to be projected is supported in the proper position in front of the objective, and the image is focused on the screen beyond. The stand of the microscope is not usually employed, since its tube is too long. It would cut off a part of the image from the screen. No eyepiece is used. You would better call upon the teacher of science in your high school, who would show you the whole apparatus, for there is probably one in the high school of your town. The best description of the instrument is to be found in Dolbear's "Art of Projecting," price $2 by mail. Your sketch would not answer the purpose. You could not make one of the size shown. A beam of light so large when condensed on an object would melt it. Nothing could stand it.

(8016) F. L. S. asks how a small Wimshurst machine is connected to a Holtz machine when used to excite the Holtz machine? A. Connect the discharging rods of the Wimshurst to the exciting brushes or the armatures of the Holtz machine. When the Holtz machine is charged, disconnect. A switch can be used for connecting and disconnecting the Wimshurst exciting machine.

(8017) W. O. M. asks: Will you please inform me if the armature of the motor described in SUPPLEMENT 641 will do for a dynamo, provided it has properly designed fields? If so, about what would the current be in volts and amperes if fields were excited from another source? A. The motor of SUPPLEMENT 641 is a dynamo if power be applied to it to drive the armature. It will give more current if the fields are excited from an external source; probably about the same, or nearly the same, current as is required to drive it as a motor.

(8018) W. G. asks: 1. Are better results obtained by including Leyden jars in the circuit of a Roentgen ray tube? A. No Leyden jars are required with an induction coil in operating an X-ray tube. With a static machine the Leyden jars are required and are a part of the machine, always in place when the strong spark discharge is produced. 2. Is thin copper better for the sectors of a Wimshurst than tin-foil and does it decrease the output if air bubbles are under them? A. Any metallic foil will answer for the sectors of a static machine. One metal is as good as another for this use. Aluminium would be preferable because of its lightness and its retention of its polish. 3. Mention SUPPLEMENT fully describing the new Wimshurst; one giving directions to build a machine of suitable size for amateur investigations. A. We have a number of SUPPLEMENTS upon the Wimshurst machine—Nos. 548, 584, 647, 914, 948, and 1131. Price ten cents each.

(8019) W. G. W. asks: Can a fundamental, when sounding, produce undertones as well as overtones under any conditions? If so, what are the laws governing the same? Can you tell me where I can obtain a book which illustrates and describes in detail Chladni's figures? A. Fundamental tone alone cannot produce any other tone except a body capable of sounding in sympathy with its tone is near. Then the same tone is produced by that body. The lower tones to which you refer are probably combination tones, "difference tones," they have been called. You will find them treated in Tyndall's Lectures on Sound, price $2 by mail. Also in Helmholtz's Sensations of Tone, price $9.50. Chladni's figures are given in Tyndall's book, mentioned above.

INDEX OF INVENTIONS
For which Letters Patent of the United States were Issued for the Week Ending DECEMBER 18, 1900, AND EACH BEARING THAT DATE.

[See note at end of list about copies of these patents.]

Adjustable hoop, J. H. Green	664,082
Aerating machine, liquid, W. Hill	664,150
Air compressor, H. M. Salyer	664,230
Air compressors, regulator for electrically actuated, E. M. Hewlett	664,086
Alarm. See Low water alarm.	
Amalgam press, A. Mackay	664,330
Ammunition clip, F. M. Garland	663,880
Annealing furnace, G. W. Packer	664,173
Armor plate, A. B. Donaldson	663,961
Atomizer, R. Morrill	663,907
Autographic register, F. J. Nutting	664,359
Axle repairing machine, vehicle, J. A. Reynolds et al.	664,008
Back pedaling brake, Anthony & Cunnius	663,842
Bag lock, telescoping, Holman & Gangolf	664,043
Bake pan, G. R. McMullen	663,921
Barrel head, Copperfield & Justice	663,866
Barrel machine, J. S. Wright, Jr.	664,205
Bath cabinet, vapor, G. W. Merker	664,282
Battery. See Galvanic battery. Primary battery. Secondary battery.	
Bearing for rolls, end, Foley & Rogers	664,251
Bed, C. W. Santmyer	663,934
Bedstead, A. F. Old	664,094
Beer cooler, A. Plawin	664,227
Belt fastening, H. Hubbell	663,977
Bicycle, G. G. Kerr	664,274
Bicycle, O. J. Lawry	664,052
Bicycle brake, J. W. Johnson	663,908
Bicycle brake, Lindberg & Olson	663,913
Bicycle foot pump, W. H. Perkins	664,286
Bicycle support, J. C. Rieger	664,353
Bicycles, pneumatic cushioned seat post for, J. W. Stoll	664,184
Binder knotter, Gagnon & Joness	664,253
Binder lock, C. H. Stoelting	664,107
Black plate, or other sheets, manufacturing, W. C. Cronemeyer	664,128
Boat keel, movable, A. E. Preston	663,982
Body brace, S. N. Fitzpatrick	664,250
Boiler tube cleaner, W. D. Forsyth	664,140
Bolt, J. O'Meara	664,027
Book support, A. S. Albright	664,031
Boot or shoe, R. Hormann	664,044
Boot or shoe polishing device, S. J. Mills	664,143
Bottle, N. W. Davis	664,350
Bottle cap, A. V. Whiteman	663,988
Bottle closure, Lockhart & Klein	664,033
Bottle holder, T. C. Bates	664,117
Bottle, non-refillable, J. A. Beck	663,952
Box for matches, cigarettes, cigars, confections, etc., A. J. Fredrikson	664,141
Brace. See Body brace.	
Braid, Thun & Janssen	664,064
Braiding machine, Janssen & Thun	664,047
Brake, H. A. Denney	664,213
Brake shoe, J. R. Cardwell	663,958
Brick kiln, H. C. Dunn	664,136
Brick truck, J. M. Gunkle	664,145
Bricklayer's gage, McClellan & Heaton	663,975
Brooding and hen house, A. Markwell et al.	663,916
Brush, J. F. Mumford	663,973
Bucket, J. Harth, Jr.	664,147
Buckle, L. I. Friedenberg	663,877
Budding implement, W. Nelson	664,172
Building assembly, H. M. Williams	663,950
Buoy, bell, E. G. P. Smith	663,941
Burner. See Gas burner. Hydrocarbon burner.	
Butter cutting apparatus, R. Kopp	664,021
Button, collar, O. W. Young	664,307
Button die, J. C. Byrne	663,860
Button or stud, H. M. Larter (reissue)	11,878
Button polishing machine, J. A. Shoemaker	664,101
Cake beating machine, N. Thomas	663,942
Calcium carbid, manufacture of, J. M. Morehead	664,334
Calculating machine, H. J. Hanson	663,890
Call register or service meter circuit for switch-board apparatus, G. K. Thompson	664,191
Can. See Creaming can. Oil can.	
Can filler, measuring, S. A. Berry	664,075
Can filling machine, F. B. Fulton	664,142
Can opener, C. A. & O. Anderson	664,033
Can opener, H. L. Bailey	663,846
Canal, pleasure, G. W. Schofield	664,179
Candle, W. R. Ellis	664,246
Car, convertible dump, H. S. Hart	664,268
Car fender, P. Best	664,309
Car heating device, F. F. Coggin	664,076
Car ventilation, W. E. Andrew	664,113
Car ventilator, W. E. Andrews	664,112
Carpet renovator, J. S. Thurman	663,943
Carriage body, F. Menzer	664,090
Cartridge, A. Barrallon	664,116
Case. See Packing case. Shirt case.	
Casein, making soluble, W. A. Hall	664,318
Cask pitching apparatus, Theurer & Beck	664,009
Chain, C. W. Levalley	664,161
Chain, drive, W. H. Gates	664,256
Chair. See Convertible chair. Massage chair. Reclining chair.	
Chuck, drill or bit, J. J. Crippin	664,127
Churn dasher, M. V. B. Trent	664,302
Cigar bunching machine, H. C. Greve	663,964
Cleaner. See Boiler tube cleaner. Comb cleaner.	
Clip. See Ammunition clip.	
Clock, electric, U. L. Collins	664,348
Clock pinions, machine for making, T. W. R. McCabe	663,998
Cloth shearing machine, T. H. Green	664,040
Clothes drying apparatus, E. F. Ede	663,873
Clutch, friction, De Dion & Bouton	664,038
Cock, stop and waste, J. H. Johnson	664,364
Cockroach trap, T. J. May	664,056
Coin holder, C. A. Herr	663,896
Coke, manufacturing, A. M. Edwards	664,017
Collar, horse, A. B. Harris	664,267
Column, segmental or sectional, G. Doane	664,239
Comb cleaner, J. H. Wheeler	664,030
Commutator, F. Kaeferle	664,219
Computing machine, H. J. Hanson	663,891
Concrete mixer, S. P. McKelvey	663,999, 664,000
Conductors of the second class, system for heating, C. D. Raab	663,929
Confectioner's pan, I. Allegretti	664,206
Contact parts, system of non-interchangeable, R. Hundhausen	664,046
Controller switch, N. Vance	664,195
Convertible chair, H. H. Paine	664,095
Cooking utensil, F. E. Corwin	664,314
Cooler. See Beer cooler.	
Cooler, C. Strobel	664,186
Corn, device for separating germs from hulls of, T. Gaunt	664,261
Corset, M. A. S. Golden	664,214
Corset, J. B. Ryan	664,294
Corset attachable device, S. Kernwein	664,220
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Dental floss holder, J. W. Cowan	664,1[illegible]
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Drier. See Rotary drier.	
Drill. See Ratchet drill.	
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Drum tone sharpener, E. Boulanger	663,853
Dyeing centrifugal, J. C. Hamer	663,888
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Electric furnace, J. M. Morehead	664,333
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Electric machines, dynamo, J. B. Entz	664,247
Electric machines, operating dynamo, W. L. R. Emmet	664,077
Electric meter, E. S. Halsey	664,265
Electric motor, alternating current, E. Thomson	664,190
Electric switch, C. W. Scott	664,061
Electric connection, W. Gerhardt	664,144
Electrical distribution system, C. P. Steinmetz	664,105, 664,106
Electricity meter, Mordey & Fricker	664,092
Elevator. See Grain elevator.	
Elevator, J. Hadfield	664,041
Elevator gate, A. C. Booth	663,953
Elevator safety appliance, L. M. & M. F. Doty	664,133
Elevators, means for preventing accidents in, Roth & Brooks	664,293
Enamel ware, ornamental, Hughes & McGowan	664,321
End gate, E. A. Henderson	663,966
Engine. See Gas engine. Gasolene engine. Internal combustion engine. Pumping engine. Rotary engine. Steam engine.	
Engine igniter, explosion, C. O. White	664,110
Engine igniter, gas or oil, A. T. Otto	664,360
Entomological specimens, mount for, W. D. & R. W. Denton	664,132
Evaporating apparatus, A. Denaeyer	664,015
Excavator, submarine, J. E. Walsh	664,010
Exercising apparatus, W. J. Bryon, Jr.	664,210
Fare register, J. O. Sloan	664,103
Farrier's knife, J. W. Polchow	664,175
Fastener, W. B. H. Dowse	664,242
Faucet, A. O'Brien	663,979
Feed, manufacturing cattle, T. Gaunt	664,262
Feed regulator, J. Hutchison	663,902
Feed trough, F. B. Dobensky	664,241
Fencing machine, wire, N. S. Parker	664,174
Fender. See Car fender.	
Filter, E. A. Leland	664,280
Filter bed, J. C. Wallace	664,196
Filter screen, accessible, I. H. Jewell	664,088
Fire alarm telegraph box, L. G. Woolley	664,366
Firearm, automatic, A. Burgess	663,954 to 663,956
Firearm lighting attachment, R. B. Benjamin	664,074
Fire escape, T. F. Browder	663,856, 663,857
Fire escape, B. S. Neelly	663,922
Fireproof grain bin, elevator, etc., E. V. Johnson	664,325
Fireproof grain bins, elevators, etc., construction of, E. V. Johnson	664,324
Fireproof window, W. J. Larkin	664,356
Flood gate, Frank & Kuhlman	664,078
Floor smoothing and polishing machine, S. A. Bishop	664,232
Fluid compressor, high-pressure, N. A. Christensen	663,862
Fly destroying device, C. V. Cudlipp	663,869, 663,870
Form, collapsible dress skirt, E. M. Case	663,861
Furnace. See Annealing furnace. Crucible furnace. Electric furnace. Ore roasting furnace. Refuse consuming furnace.	
Furnace, F. H. Becker	664,034
Gage. See Bricklayer's gage. Draw gage. Micrometer gage. Water gage.	
Galvanic battery, C. B. Schoenmehl	663,936, 664,006 to 664,008
Galvanic battery, E. L. Slocum	664,362
Game table, W. H. Fullington	663,878
Garment fastening device, J. P. Cooper	664,212
Garment hanger, J. C. Messinger	664,332
Garment hanger, F. A. Stare	664,063
Gas apparatus, J. P. Johnston	664,355
Gas burner, adjustable, P. G. Van Wie	664,364
Gas engine, L. H. Nash	664,025
Gas generator, acetylene, V. T. Weathers	664,029

(Continued on page 415)

Gas light extinguisher and electric sparker, combined automatic, G. H. Lippmann.... 664,163
Gasolene engine, C. O. White.... 664,300
Gate. See End gate. Flood gate.
Gearing, changeable speed and reversible friction, J. W. & O. P. Shaver.... 663,940
Generator. See Gas generator.
Glass articles, apparatus for manufacturing hollow, P. T. Sievert.... 664,102
Glassware articles, apparatus for glazing and finishing, A. Roemisch.... 664,058
Globe, geographical time, G. W. Ramage.... 664,289
Glove fastener affixing machine, A. F. Raymond. 664,220
Gloves, etc., forming pockets of separable fasteners for, W. B. H. Dowse.... 664,243
Gold separator, W. W. M. Hickey.... 663,903
Golf practicing device, H. H. Sprague.... 664,338
Governor, centrifugal, A. Schulze.... 664,336
Grain elevator, E. V. Johnson.... 664,323
Grain elevator, portable, H. H. Weber.... 664,303
Grinding machine, F. E. Whitham.... 664,302
Grindstone disk supporting attachment, W. W. Hewitt.... 664,149
Gun fluid brake, J. Krone.... 664,069
Hair shedder, W. Herr.... 663,897
Hanger. See Garment hanger.
Harness pad former, J. A. Kramer.... 664,379
Harvesting and shock forming machine, corn, H. Roush.... 663,981
Hat brim trimmer, J. R. Griffeth.... 663,965
Hat mounting band, Burt & Harris.... 663,957
Hat pouncing machine, W. H. Lyons.... 664,324
Hay or load binder, F. Gardner.... 664,255
Hay press, E. R. Bryant.... 664,253
Hay sling, G. A. Olson.... 664,057
Heat by combustion of fuel, generating, W. B. Wilkinson.... 664,304
Heater attachment, L. D. West.... 663,987
Heating apparatus, electrical, C. Goblin.... 664,081
Hitching device, horse, N. L. Goodwin.... 663,881
Hoist lowering brake, W. S. Halsey.... 663,886
Hoisting machinery, H. C. Behr.... 664,073
Holder, J. Gibbs.... 664,332
Hook. See Scaffold hook. Suspension hook.
Hoop. See Adjustable hoop.
Hopple, Gorringe & Read.... 664,263
Horseshoe holder, E. F. Meyer.... 664,226
Hose truck, C. F. W. Doehring.... [illegible]
Hotel register, C. E. Eistner.... [illegible]
House. See Brooding and hen house.
Hydrocarbon burner, G. H. Larkin.... 664,022
Incubator, J. B. Ranney.... 663,984
Indicator. See Electric circuit indicator. Liquid level indicator.
Insulator, R. H. Sterling.... 664,301
Insulator, electric, E. Risler.... 664,176
Internal combustion engine, J. Dougill.... 664,134
Iron. See Soldering iron.
Ironing board, J. Herpel.... 664,148
Ironing table, G. W. Buss.... 664,192
Jack. See Lifting jack.
Joint. See Rail joint.
Keg, barrel, or cask, C. W. Stran.... 664,185
Key ring, W. F. Peet.... 664,295
Kiln. See Brick kiln.
Knife. See Farrier's knife.
Knitting machine, circular, H. E. Harbaugh.... 664,296
Knitting machine, straight, H. A. Houseman, 663,900, 663,901
Knitting machine yarn guide, H. I. Jones.... 664,273
Lace holder, shoe, B. F. Shepherd.... 664,182
Lacing guide, L. A. Roberts.... 664,005
Ladle for molten metal, Waldburger & Smith.... 663,945
Ladles, power apparatus for removing skull from, Waldburger & Smith.... 663,946
Lamp clutch, electric arc, C. E. Harthan.... 664,068
Lamp cover or shade, incandescent, W. R. Krumwiede.... 664,222
Lamp, electric arc, J. A. Brennan.... 664,209
Lamp, night, C. Moegling.... 664,167
Last, darning, W. H. Snyder.... 664,104
Lathe, axle turning, F. O. Sandstrom.... 663,933
Lawn sprinkler, J. L. Turner.... 664,067
Leather punching machine, J. Wester.... 663,949
Leg band, sealed, W. H. Smith.... 664,062
Lifting jack, J. T. Sanders.... 663,932
Lighting device, time, W. W. Bollen.... 663,852
Liquid level indicator, A. Le Blanc.... 664,328
Loading device, T. J. Pratt.... 664,286
Lock. See Bag lock. Binder lock.
Lock, J. A. Eastman.... 664,245
Lock and latch, G. C. Craig.... 664,315
Lock for safety deposit boxes, A. R. Fergusson.. 663,876
Loom clutch mechanism, M. A. Schmitt.... 663,935
Loom shedding cams, oil guard for, E. S. Stimpson.... 664,330
Loom, weft replenishing, Cunniff & Draper.... 664,317
Low water alarm, F. Aldrich.... 664,111
Lubricating apparatus, L. Serpollet.... 664,180
Lubricator, D. R. MacBain.... 664,170
Lubricator, E. McCoy.... 663,976
Mail bag catcher and deliverer and railway appliance therefor, L. D. Jobes.... 664,271
Massage chair, Johnston & Vanorman.... 663,909
Measuring and registering apparatus, G. W. Johnson.... 664,272
Measuring device, automatic, A. S. Collins.... 664,349
Measuring instrument, F. E. Kim.... 664,276
Mechanical movement, W. K. Hodgman.... 664,151
Mercerizing machine, A. Kortesz.... 664,275
Metal, machine for making expanded, G. A. Turnbull.... 664,193
Metal objects by fluid pressure, shaping and embossing, C. Huber.... 664,045
Metal, working, G. S. Merrill.... 664,091
Meter. See Electric meter. Electricity meter.
Micrometer gage, A. A. Brandt.... 664,120
Micrometer gage, E. C. Clapp.... 664,211
Microtome, A. Becker.... 664,118
Milker, cow, R. D. Roth.... 663,930
Mill. See Sawmill.
Mills, factories, etc., protective appliance for, M. Martin.... 664,331
Mirror, J. B. Williamson.... 664,365
Mixer. See Concrete mixer.
Moistening device, T. J. Houtman.... 664,155
Mortising machine, E. F. Meyer.... 664,225
Motion, device for imparting rotary, G. A. Ryd.. 664,028
Motor. See Electric motor. Vehicle motor.
Motor control system, A. H. Armstrong.... 663,951
Motor switch, H. Geisenhoner.... 664,080
Music leaf turner, C. M. Wood et al.... 664,204
Napkin holder, J. W. Ensley.... 663,874
Nipple wrench, W. Earl.... 664,244
Nozzle tip, exhaust, F. W. & H. L. Shupert.... 664,298
Oil can, D. E. McDonald.... 664,093
Oil stone, M. B. Hill.... 664,319
Oil tank and pump, B. F. D. Miller.... 664,283
Opera glass, coin operated, W. R. Wheeler.... 664,343
Ore mixing machine, J. P. Schuch, Jr.... 664,059
Ore roasting furnace, F. W. Holtman.... 664,153
Ores, treating, H. Luckenbach.... 663,914
Packing case, I. L. Hauser.... 664,084
Packing case for tableware, J. Pettibone.... 664,287
Packing ring, E. E. Gallup.... 663,879
Packing ring for piston rods, duplex, O. J. Garlock.... 664,143
Paint, heat insulating, J. Hommel.... 664,154
Pan. See Bake pan. Confectioner's pan. Preserving pan.
Paper box, E. T. Crump.... 664,316
Paper box, C. Gaile.... 663,963
Paper damping machine, H. Manegold.... 664,055
Paper feeding machine, C. A. Sturtevant.... 664,340
Paper perforator, C. Scofield.... 664,296
Passage closing device, coin controlled, S. E. Stimson.... 663,985
Paving, street, P. J. Moran.... 664,024
Perforating record strips, machine for, T. Lanston.... 663,906
Phonograph record, T. B. Lambert.... 664,223
Piano action, H. R. Moore.... 664,168
Piano, electrical, S. S. Reynolds.... 664,004
Picture frame support, J. T. Mumford.... 663,974
Pipe, cigar holder, and cigarette holder, combination, P. Fischer.... 664,139
Pipe coupling, F. Kaeferle.... 664,218
Pipe coupling, universal, J. R. Reniff.... 664,291
Planter, corn, J. F. Graham.... 664,264
Planter, seed, S. A. Allen.... 664,072
Plow, P. McNaughton.... 663,977
Plow, pulverizing, R. T. Gillespie.... 663,901
Plow sod cutting attachment, F. Gardner.... 664,254
Plow, wheeled, S. H. Tinsman.... 664,100
Pocket, garment, R. Bartell.... 663,849
Polishing wheel, L. Levett.... 663,912
Power transmitting machinery, J. Herbe.... 663,895
Precious metals from their ores, extracting, J. P. Schuch, Jr.... 664,060
Press. See Amalgam press. Hay press.
Press, F. H. Bancroft.... 663,847
Primary battery, C. B. Schoenmehl.... 663,937
Printing in one or more colors, machine for, Bouvet & Fix.... 664,119
Printing machine bed motion, cylinder, W. Scott.... 664,100
Printing machine, collotype or similar, A. Coe.... 663,864
Printing press bed motion, W. K. Hodgman.... 664,216
Prospecting pan, J. Tobin.... 664,096
Pulley, J. C. Pratt.... 663,928
Pulley block, E. S. Knight.... 663,905
Pulp, treatment of wood, F. C. Crean.... 663,868
Pump, J. T. Walker.... 664,069
Pumping engine, steam, F. M. Leavitt.... 663,909, 663,910
Punch, C. E. Smith.... 664,289

(Continued on page 416)

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Railway signaling device, H. B. Benjamin........ 664,207
Railway switch, C. A. Dunn........ 663,873
Railway switch, S. S. Shields........ 664,178
Railway switch and means for operating same, J. W. Koch........ 663,907
Railway switch, automatic, R. D. Seibert........ 664,297
Railway system, electric, W. B. Potter........ 664,096
Railway tie, metallic, W. H. Hillyer........ 664,042
Railway track construction, metallic, G. B. Harper........ 664,020
Ratchet drill, W. S. Halsey........ 663,887
Razor, safety, A. W. Scheuber........ 664,177
Razor stropping device, F. Francis........ 664,252
Reclining chair, H. J. Jacobs........ 664,322
Reel. See Yarn reel.
Refrigerator and milk cooler, combined, S. S. Arnold........ 663,943
Refuse consuming furnace, W. J. Glen........ 664,039
Register. See Autographic register. Fare register. Hotel register. Telephone call register.
Register, I. R. Kuhlman........ 663,994
Regulator. See Feed regulator. Speed regulator.
Rheostat, automatic, E. M. Hewlett........ 664,087
Rifle, W. B. Nicholson........ 663,988
Ring. See Key ring. Packing ring.
Rod. See Curtain rod. Drum rod.
Rolling apparatus, sheet, W. C. Cronemeyer........ 664,129
Rotary drier, Taylor & Kohn........ 664,187
Rotary engine, C. W. Hoffmann........ 664,320
Rotary engine, A. L. Scudder........ 663,939
Rotary engine, G. W. Whitehead........ 664,201
Roundabout system, A. D. Weil........ 663,948
Rubber heel for shoes, W. W. Comingor........ 663,965
Saddle, harness, R. D. Murphy........ 663,930
Salt cellar or flour dredge, J. Putnam........ 664,228
Sanitary appliance, A. O'Brien........ 663,978
Sash fastener, G. E. Link........ 664,162
Saw filing machine, S. W. Gutridge........ 663,992
Saw handle, J. Jett........ 664,048
Sawmill, band, E. E. Thomas........ 664,188
Sawmill guide, band, E. E. Thomas........ 664,108
Saw vise and tool basket handle, combination, H. C. Walbaum, Jr........ 664,342
Sawing machine, circular, F. H. Clement........ 663,863
Sawing machine, scroll, T. Curley........ 663,871
Scaffold hook, R. B. Gregory........ 663,883
Screws, nuts, etc., from rough metal, machinery for automatically manufacturing, W. Roh........ 664,008
Seat. See Spring seat.
Secondary battery, F. W. Wetherill........ 664,198
Separator. See Gold separator.
Sewage, etc., ejector for raising, Shone & Ault........ 664,183
Sewing machine guide, G. W. Lasch........ 663,908
Sewing machine trimmer, H. A. Klemm........ 664,277
Sewing machines, gumming mechanism for book, D. M. Smyth........ 664,300
Sharpener, harrow disk, T. L. Regester........ 664,097
Sheet metal ware, F. Wiley........ 664,070
Shell blank cutting machine, Kidd & Wurster........ 664,221
Shirt case, L. W. Peddicord........ 663,927
Shutter, door or window, J. G. Wilson........ 663,989
Shutter retainer, N. Martin........ 664,164
Shutter worker, A. M. Burnham........ 663,858
Sign, L. Johnson........ 664,049
Sign, advertising, J. G. Hansen........ 663,892
Signal. See Railway signal.
Signal box auxiliary attachment, B. Oehmen........ 663,926
Siphon filler and mineral water charger, J. H. Fox........ 664,351
Skirt, pedestrian's, E. M. Reynolds........ 664,002
Sled, R. E. Hickson........ 664,215
Smoke conveyer, G. M. Melven et al........ 663,917
Soap making apparatus, Culmann & Witter........ 664,130
Soldering iron, E. Booth........ 664,310
Soldering tool, F. G. Raleigh........ 663,983
Sounding tube for navigator's use, J. E. Benedict........ 663,850
Spectacles, electrotherapeutic, T. B. Zoller........ 664,308
Speed regulator, L. H. Nash........ 664,026
Sprayer, kerosene, W. L. Deming........ 664,237
Spraying apparatus agitator, W. L. Deming........ 664,238
Spring for couches, seats, etc., A. T. Knorzer........ 664,051
Spring seat for chairs, sofas, wagon seats, etc., M. D. Kilmer........ 664,158
Sprinkler. See Lawn sprinkler.
Stamp, rotary self inking, M. Tilden........ 663,944
Stand. See Washstand.
Starch and cattle food, making, T. Gaunt........ 664,257
Starch, manufacture of, T. Gaunt........ 664,260
Starch, separating germs, etc., in making, T. Gaunt........ 664,259
Starch, treating grain in making, T. Gaunt........ 664,258
Steam engine, P. Heubner........ 664,270
Steam engine, W. Loeffler........ 663,972
Steam generator, T. F. Morrin........ 664,357, 664,358
Stocking, C. J. Sadler........ 664,295
Stokers, feeding device for steam, F. W. Cox........ 663,867
Stone, veining or marbling artificial, H. E. G. Uhlig........ 664,194
Stones, bricks, etc., producing artificial building, P. Kleber........ 663,904
Stop mechanism, automatic, C. F. Van Dyke........ 664,068
Submarine apparatus, A. von Hoffmann........ 664,152
Suspension hook, G. A. Jencke et al........ 664,217
Sweeper and dust gatherer, electric, C. Dufour........ 664,135
Switch. See Controller switch. Electric switch. Motor switch. Railway switch.
Switch cap, electrical, G. B. Thomas........ 664,180
Switch stand lever locking mechanism, W. F. Knox........ 663,906
Table. See Display table. Game table. Ironing table.
Tank. See Oil tank.
Telegraph receiver, printing, J. Burry........ 663,859
Telegraphic instrument, H. T. Johnson........ 663,903
Telephone call register, W. H. Barker........ 664,346
Telephone mouthpieces, germ destroyer for, L. L. Lacey........ 663,995
Telpher system, J. H. & A. Pauley........ 664,284
Tenon and mortise joint, H. S. Jordan........ 664,050
Tenpin alley, R. F. Downey........ 664,016
Tentering machine swinging mechanism, J. J. Fearon........ 664,349
Thermostat, J. B. Knickerbocker........ 664,327
Thill coupling, J. Clarke........ 664,013
Thill support, buggy, J. A. Crisp........ 664,036
Tie. See Railway tie.
Tire plug machine, F. L. Wilson........ 664,306
Tile setting, Mueller & Laugenbeck........ 664,169
Tire armor, N. Brown........ 664,121
Tire bolt wrench, A. E. Groom........ 663,884
Tire fastening, vehicle, W. Holmes........ 663,899
Tire for cycles, etc., T. Burrell........ 664,035
Tires on vehicle wheels, device for securing rubber, W. Holmes........ 663,898
Tool, H. O. Breckenridge........ 664,012
Toy, motor, J. H. Whiting........ 664,203
Track sander for locomotives, pneumatic, J. B. Barnes........ 664,115
Trap. See Cockroach trap.
Tray for sample cases, trunks, etc., self adjusting, F. D. Upham........ 664,363
Tricycle, J. T. Andreen........ 664,231
Trough. See Feed trough.
Truck, car, C. M. Carnahan........ 664,312
Tube. See Sounding tube.
Turbine, compound reaction steam, J. C. Henderson........ 664,085
Turret machine tool holder, G. J. Winkle........ 664,344
Type forming machines, record strip perforator for, T. Lanston........ 663,971
Typewriter, W. Beresford........ 664,011
Typewriting machine, L. S. Burridge........ 664,347
Umbrella cover, B. W. Kilmer........ 664,157
Umbrella covers, clip for attaching, F. W. Carmelich........ 664,123
Umbrella stick, D. H. Watts........ 664,197
Valve, Grosse & Lintz........ 664,368
Valve, balanced slide, W. Schmolka........ 663,936
Valve, check, T. J. Hackett........ 664,146
Valve for trucks, safety, C. A. Warsing........ 663,947
Valve gear, W. S. Halsey........ 663,885
Valve, pumping engine, J. S. Atkinson........ 664,114
Valve, water cushioning tank, Milne & Snow........ 663,918
Valves, gripping connection for inflation, Trommlitz & Gibbs........ 664,341
Vehicle brake, automatic, H. L. Bailey........ 663,845
Vehicle hinge coupling, detachable, H. J. Chambers........ 664,234
Vehicle hitch brake, automatic, C. Kitchin........ 664,159
Vehicle motor, J. W. Eisenhuth........ 664,018
Vehicle, motor, H. B. Berendsen........ 664,208
Vehicle motor, W. Riddell........ 664,292
Vehicle, motor driven, P. C. Leidich........ 664,160
Vehicle running gear, C. Heart........ 663,893
Vehicle steering apparatus, motor, J. E. Thornycroft........ 663,986
Ventilator. See Car ventilator.
Vessel, compartment, De Lancey & Ritter........ 664,131
Vise, pipe, H. F. Renner........ 664,361
Warp beaming machine, D. McTaggart........ 664,326

(Continued on page 419)

INDEX.

ILLUSTRATIONS.

MISCELLANY.

Figures preceded by a star (*) refer to illustrated articles.

Washboard, G. W. Chatters, Sr.	664,125
Washing machine, A. A. Casler	664,124
Washstand, W. S. Hamm	663,889
Water gage, E. Engels	664,019
Water wheel governor, A. Schulze	664,337
Weighing machine, E. H. Cook	664,313
Weighing machine, A. Crawford	663,959
Weighing machine, coin controlled, E. H. Cook	664,235
Wheel. See Polishing wheel.	
Winch, R. A. McLeod	664,171
Wire splicing machine, W. F. Kintzing	664,326
Woodworking machine, P. P. Bostwick	664,311
Work support, E. Dawson	663,960
Wrench. See Nipple wrench. Tire bolt wrench.	
Wrench, L. H. Kroke	663,970
Yarn reel, M. J. Nordmann	663,925
Yoke, neck, T. De la Mare	664,236
Zinc, recovering, C. Hoepfner	664,209

DESIGNS.

Air cushion, Meinecke & Hogan	33,763
Bunion or corn shield, J. J. Georges	33,764
Car coupling cam block, P. Hien	33,753
Car coupling draw head, P. Hien	33,752
Car coupling knuckle, P. Hien	33,750
Car coupling lifting pin, P. Hien	33,755
Car coupling lifting pin lock, P. Hien	33,757
Car coupling locking pin, P. Hien	33,756
Car couplings, filling block and support for gravity acting dogs for, P. Hien	33,751
Car couplings, gravity acting dog for, P. Hien	33,754
Chandelier, L. S. Pfouts	33,731
Cribbage board, P. J. Doyle	33,766
Cycle frame, motor, G. D. Green	33,745
Display rack, W. S. McRay	33,761
Finger ring, S. Goldner	33,725
Game board, F. G. Kaelin	33,767
Hair retainer, W. S. Bechtold	33,726
Hook, hame, W. H. Hayden	33,741
Hydrocarbon burner top plate, J. C. Speirs	33,737
Jar wrench, fruit, R. Howell	33,732
Knife handle, G. M. Landers	33,728
Lubricator pump body, B. Ivor	33,747, 33,748
Match safe, H. D. Gardy	33,730
Micrometer gage frame, L. S. Starrett	33,734
Nail, hoop, C. W. Evans	33,740
Pen rack, O. R. Looker	33,727
Sad iron, H. E. Asbury	33,733
Sander apparatus, valve casing for locomotive, J. C. Hooper	33,749
Sash fastening lever, H. B. Sargent	33,739
Scale case, price, S. R. Munson	33,735
Screen roller housing, E. Timmerhoff	33,738
Shoe, W. N. Horne	33,765
Slide-D, S. H. Hull	33,742
Stand, newspaper, McDowell & Strike	33,760
Stove, A. Onnemus	33,758, 33,759
Tray, C. H. Peet	33,729
Trousers hanger, T. B. Shuman	33,762
Trunk clamp, M. N. Drucker	33,744
Trunk corner shield, M. N. Drucker	33,743
Typewriting machine type bar, A. T. Brown	33,736
Valve casing, J. W. McMillan	33,746

TRADE MARKS.

Bakery and confectionery products, certain named, Ohio Baking Company	35,597
Bicycles, Sears, Roebuck & Company	35,626
Boots and shoes and leather for same, Rice & Hutchins	35,592
Brick, fire, Stowe, Fuller & Company	35,628
Cereal products, certain named, Malted Cereals Company	35,599
Coffee, F. P. Garrettson & Company	35,596
Cologne water, J. M. Farina	35,604
Dairy products, certain named, Borden's Condensed Milk Company	35,600
Eye shades, W. F. Mahony	35,590
Flour, gluten, Bennett Milling Company	35,598
Forms, bust, Wright & Company	35,591
Fruit, dried or evaporated, U. H. Dudley & Company	35,594
Hair tonic, A. F. Richardson	35,605
Hardware, cutlery, and edge tools, James C. Lindsay Hardware Company	35,627
Kidney, blood, and nerve cure, J. Loomer	35,607
Medicated plasters, R. Thomas, Jr.	35,609, 35,610
Medicine, tonic, C. H. Grube	35,606
Milk, condensed, St. Louis Condensed Milk Company	35,601
Musical instruments excepting pianos and their parts, J. Thibouville-Lamy & Company	35,612
Ointment, C. A. Torrey, Jr.	35,608
Organs, Sears, Roebuck & Company	35,613 to 35,621
Packing house products, certain named, Libby, McNeill & Libby	35,602
Paint and varnish remover, certain named, Cellulose Products Company	35,611
Pianos, Sears, Roebuck & Company	35,622, 35,623
Sewing machines, Sears, Roebuck & Company	35,624, 35,625
Sheets, cotton, D. J. Vlasto	35,593
Soda fountains, sirup dispensed in, J. Hungerford Smith Company	35,595
Tobacco, plug, M. C. Wetmore Tobacco Company	35,603

LABELS.

"Berg's Famous Bread," for bread, C. T. Berg	7,992
"Coffee Ette," for a coffee substitute, M. A. Rawson	7,989
"Corned Beef Hash," for corned beef hash, Valentines Meat Juice Company	7,995
"Dailey's Pure Malt," for extract of malt, H. & J. Dailey Malt Company	7,982
"Daisy Blue," for cigars, Schmidt & Company	7,979
"Domino Rye Whisky," for whisky, Los Angeles Company	7,987
"Dr. Mill's Pectoral Sirup," for a cough medicine, L. G. B. Erb	7,971
"Dreyfus' Pills," for a medicine, N. Khasan	7,972
"Eddie's German Sal-Len," for a medicine, Smith Brothers	7,974
"Fox's Nutted Dates," for nutted dates, Fox Pharmacy Company	7,990
"Greenabaum Brothers Plum Pudding," for plum pudding, Greenabaum Brothers	7,991
"Hale's Ton-A-Quin for the Hair," for a hair tonic, H. R. Hale Company	7,967
"Kil-Kold," for a medicine, A. Meyers	7,973
"La Rosa Calle," for cigars, Schmidt & Company	7,978
"Lustre," for a polish, W. L. Paul	7,976
"Mayflower Rye," for whisky, Los Angeles Company	7,985
"Mueller's Macaroni Flag Brand," for macaroni, C. F. Mueller & Company	7,994
"Olden Time Rye Whisky," for whisky, Los Angeles Company	7,984
"Oppeau's Treatment for the Hair," for a remedy for baldness, J. Oppeau	7,968
"Ox Tongue," for potted meats, Valentine's Meat Juice Company	7,996
"Ox Tongue," for potted ox tongue, Valentine's Meat Juice Company	7,998
"Potted Beef," for potted beef, Valentine's Meat Juice Company	7,997
"Raceabout Rye," for whisky, Los Angeles Company	7,988
"Red Raven Dentine," for a tooth and mouth wash, Meyer & Gleim	7,970
"Refugee Stringless Beans," for canned beans, United States Printing Company	7,993
"Rolo Polo Solitaire or Two Ball Hockey," for a game, L. F. Jordan	7,966
"Seltone," for a catarrh cure, Specialty Manufacturing Company	7,969
"Sierra Mineral Bath Crystals," for a compound for the bath, E. Griswold	7,975
"Upmann's Extra 5," for cigars, C. Upmann	7,980, 7,981
"Will B.," for cigars, W. Baum	7,977
"Winner Whisky," for whisky, Los Angeles Company	7,986
"Wm. Ulmer Brewery," for lager beer, Wm. Ulmer Brewery	7,983

PRINTS.

"The Stubborn Donkeys," for a puzzle, F. A. Schessow	284

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